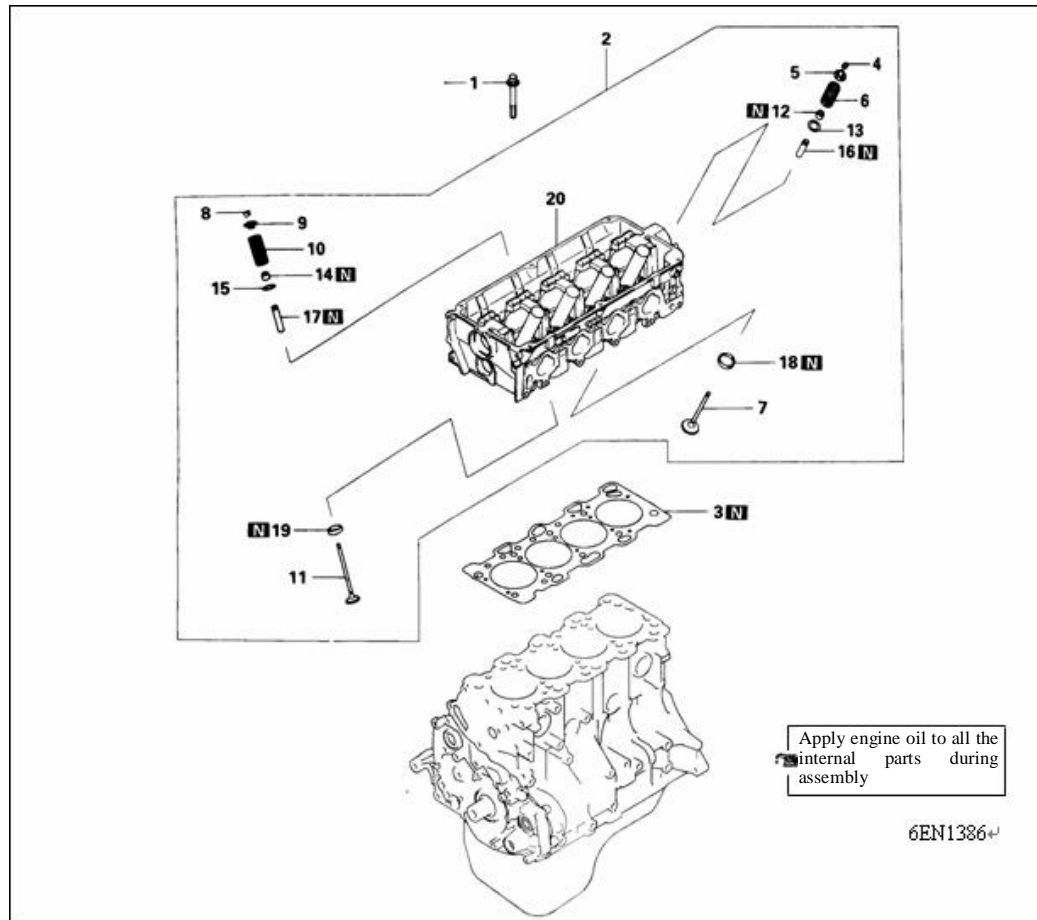


## Cylinder Head and Air Valve



### Removal Steps

- |                            |                          |
|----------------------------|--------------------------|
| 1. Cylinder head bolt      | 11. Exhaust valve        |
| 2. Cylinder head assembly  | 12. Valve seal           |
| 3. Cylinder pad            | 13. Valve spring seat    |
| 4. Valve lock clamp        | 14. Valve seal           |
| 5. Valve spring upper seat | 15. Valve spring seat    |
| 6. Valve spring            | 16. Inlet valve pipe     |
| 7. Air inlet valve         | 17. Exhaust valve pipe   |
| 8. Valve lock clamp        | 18. Air inlet valve seat |
| 9. Valve spring upper seat | 19. Exhaust valve seat   |
| 10. Valve spring           | 20. Cylinder head        |

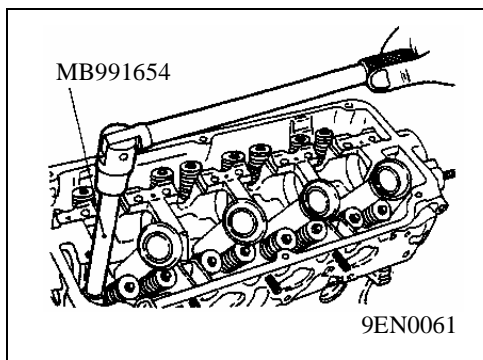
### Notice for Removal

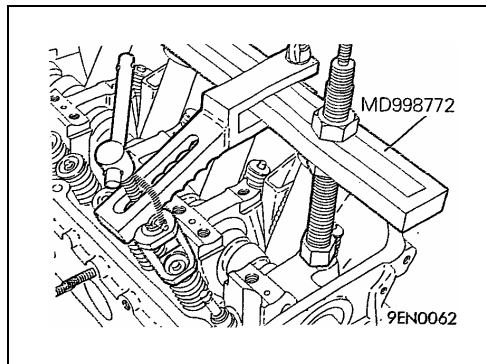
#### Caution after Removal:

Manage the removed parts according to their cylinder number and inlet/exhaust difference.

#### Removal of Cylinder Head Bolt

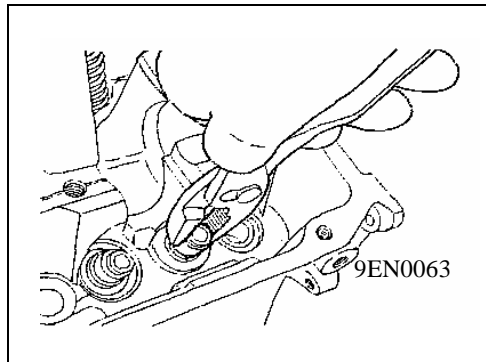
- (1) Loosen all the cylinder head bolts by using the special tool.  
Loosen the bolts evenly and gradually.





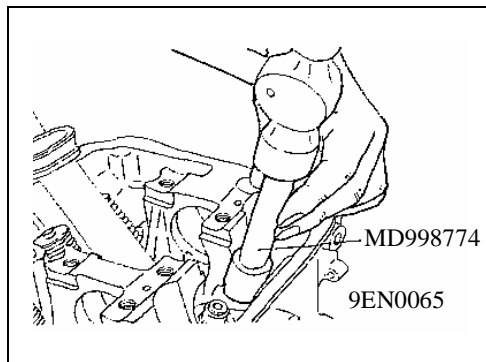
### Removal of Valve Lock Clamp

- (1) Hang tags with cylinder number and installation position on the removed valve, spring and other parts, and keep them well for convenience of assembly.



### Removal of Valve Seal

- (1) Valve seal is not reusable.

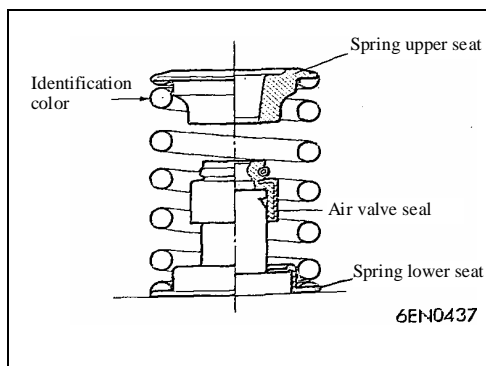


### Notice for Installation

#### Installation of Valve Seal

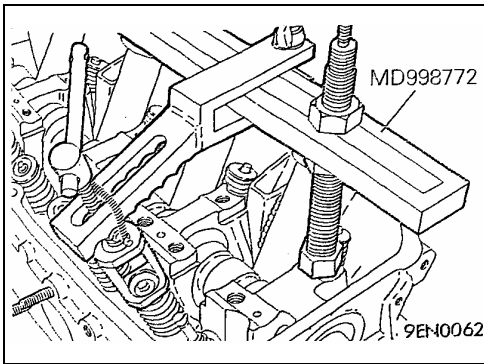
- (1) Install the valve spring lower seat.
- (2) By using special tool, install the valve seal on the valve pipe.  
Improper installation may cause leakage.

**Caution:** • Valve seal is not reusable.



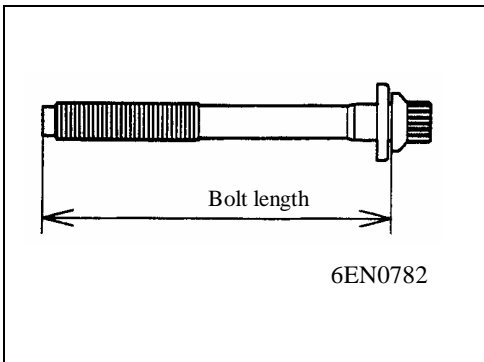
### Installation of Valve Spring

- (1) Install the valve spring with the end coated with identification color facing the valve spring upper seat.



### Installation of Valve Lock Clamp

- (1) Excessive compression of the valve spring may cause the bottom end of valve spring upper seat to contact with it, resulting in damage to the valve seal.

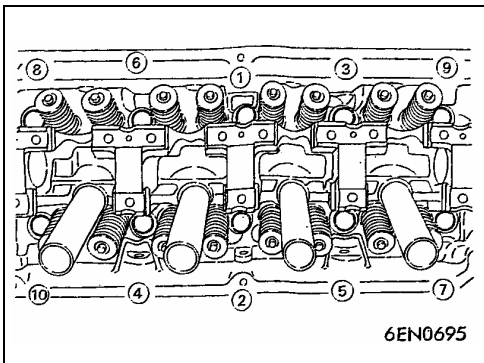


### Installation of Cylinder Head Bolt

- (1) To install the cylinder head bolt, make sure that the bolt length is conformity to the limit value. If it is more than the limit value, replace the bolt.

**Limit value (A): 99.4 mm max.**

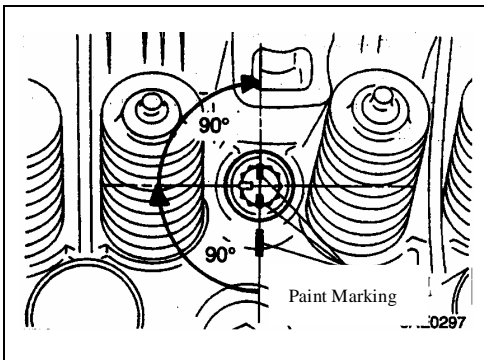
- (2) Apply oil to the thread of the bolt and the washer.



- (3) By using special tool (MB991654), tighten the bolts to stipulated torque in order.

**Tightening torque: 78N.m**

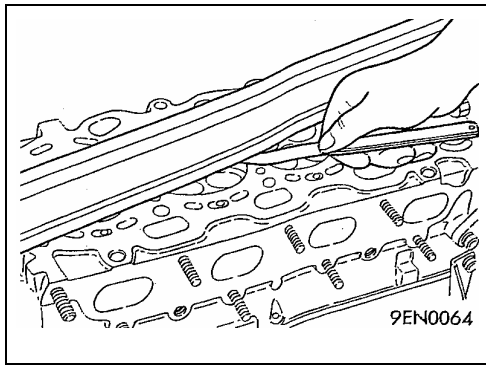
- (4) Fully loosen all the bolts.
- (5) Retighten the bolts with 20N.m torque in order.



- (6) Make paint straight-line markings on the cylinder head bolt and cylinder head.
- (7) Tighten the cylinder head bolts for 90° in order.
- (8) Further tighten the bolts for 90°, and make sure that the paint marking on the cylinder head bolt is aligned with that on the cylinder head.

### Caution:

- If the angle for tightening the bolt is less than 90°, no correct tightening torque is expected. Therefore, pay full attention to whether the tightening angle is correct when tightening.
- If the bolt is tightened excessively, loosen the bolt fully, and then repeat the tightening from Step (1).

**Cylinder Head**

- (1) Check the bottom face of the cylinder head for flatness with ruler and feeler.

**Standard value:** 0.03mm

**Limit value:** \*0.2mm

- (2) Lapping is required for correction if the deformation exceeds the limit value.

**Lapping limit value:** \*0.2mm

\* The total lapping amount including cylinder block.

**Cylinder head height (standard value of new parts):** 119.9 ~ 120.1mm

**Valve**

- (1) Check the valve operating face for correct contact. Relap with valve lapping machine if the contact is not correct. The valve seat contact face must be in conformity with the center of valve operating face.

- (2) If the edge thickness exceeds the used limit value, replace the valve.

**Standard value of edge thickness:** Inlet ..... 1.0mm  
Exhaust..... 1.2mm

**Used limit value:** Inlet..... 0.5mm  
Exhaust..... 0.7mm

- (3) Measure the total height of valve. Replace the valve if the height is less than the limit value.

**Standard value:** Inlet ..... 112.30mm  
Exhaust ..... 114.11mm

**Limit value:** Inlet..... 111.80mm  
Exhaust..... 113.61mm

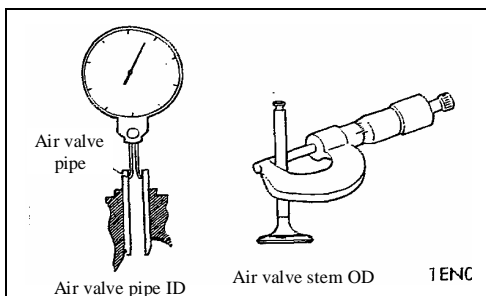
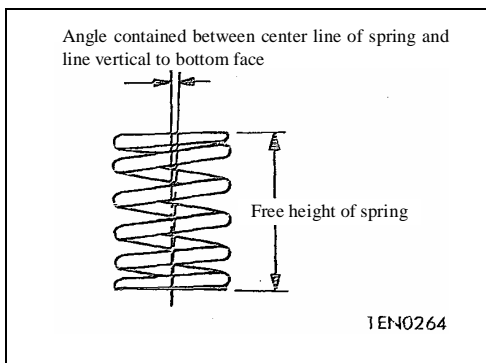
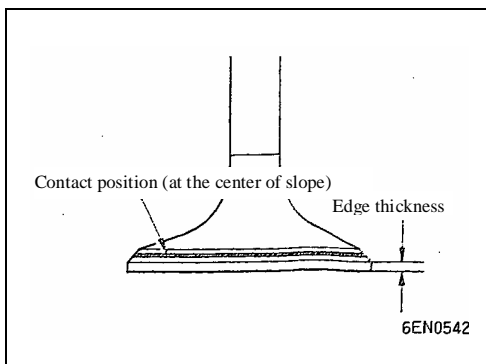
**Valve Spring**

- (1) Measure the free height of spring. Replace the valve if the height is less than the limit value.

**Standard value :** 51.0mm      **Limit value :** 50.0mm

- (2) Measure the verticality between the central line and the bottom face of the spring. Replace if the banking exceeds the limit.

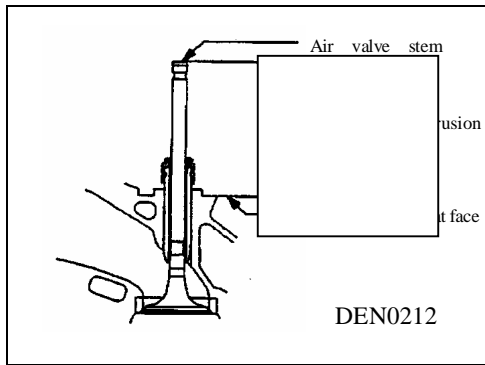
**Standard value:**  $\leq 2^\circ$       **Limit value:**  $4^\circ$

**Valve Pipe**

- (1) Measure the gap between the valve pipe and the valve stem. Replace the valve pipe or valve or the both if the gap exceeds the limit value.

**Standard value:** Inlet ..... 0.02—0.05mm  
Exhaust..... 0.03—0.07mm

**Limit value:** Inlet ..... 0.10mm  
Exhaust ..... 0.15m



### Valve Seat

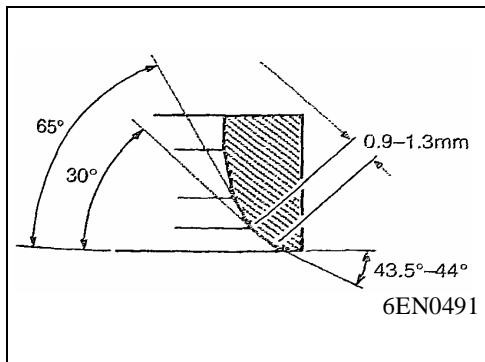
- (1) To assemble the valve, measure the protrusion height of the valve stem between the end portion of valve stem and the face of valve spring seat. If the measured value exceeds the stipulated limit value, replace the valve seat.

**Standard value:** Inlet ..... 49.30mm

Exhaust ..... 49.30mm

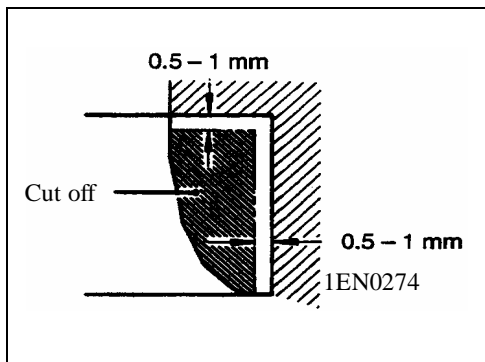
**Limit value:** Inlet ..... 49.80mm

Exhaust ..... 49.80mm



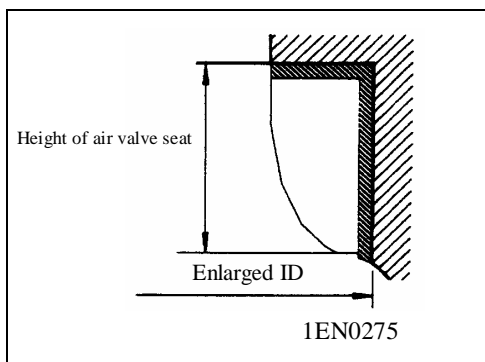
### Essentials for Repair of Valve Seat

- (1) Before repair of the valve seat, check the gap between the valve pipe and the valve stem. If necessary, replace the valve pipe first and then conduct repair.
- (2) Repair the width and angle of the valve seat to their stipulated value by using lapping machine.
- (3) After repair of the valve seat, lap the valve and the valve seat in matched pair with lapping paste. Then check the valve stem for protrusion height. (See Inspection of Valve Seat).



### Essentials for Replacement of Valve Seat

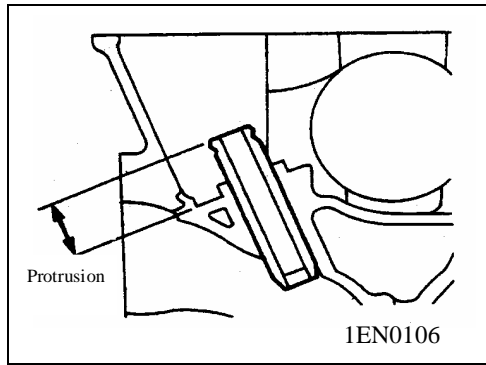
- (1) Thin the valve seat to be replaced by cutting off a part from its inner side and remove it.
- (2) Process and repair the valve seat hole in the cylinder head according to the enlarged outer diameter of the valve seat.



### Valve Seat Diameter:

Air inlet valve seat	Enlarged dimension 0.30	34.435-34.455
	Enlarged dimension 0.60	34.735-34.755
Exhaust valve seat	Enlarged dimension 0.30	31.935-31.955
	Enlarged dimension 0.60	32.235-32.255

- (3) Before assembly of the valve seat, heat the cylinder head to about 250°C, or cool the valve seat in liquid nitrogen, to prevent it from seize in the cylinder head.
- (4) By using valve seat miller, repair the valve seat to its stipulated width and angle (see Essentials for Repair of Valve Seat).



### Essentials for Replacement of Valve Seat

- (1) By using a press, push out the valve pipe in the direction of the cylinder block.
- (2) Process the valve pipe hole in cylinder head so that the hole diameter reaches the dimension of the enlarged valve pipe to be installed.

**Caution:** Do not use the new valve pipe of which the dimension is the same as that of the removed one.

### Hole diameter of upper valve pipe of cylinder head

Enlarged dimension 0.05: 11.05-11.068

Enlarged dimension 0.25: 11.25-11.268

Enlarged dimension 0.50: 11.50-11.518

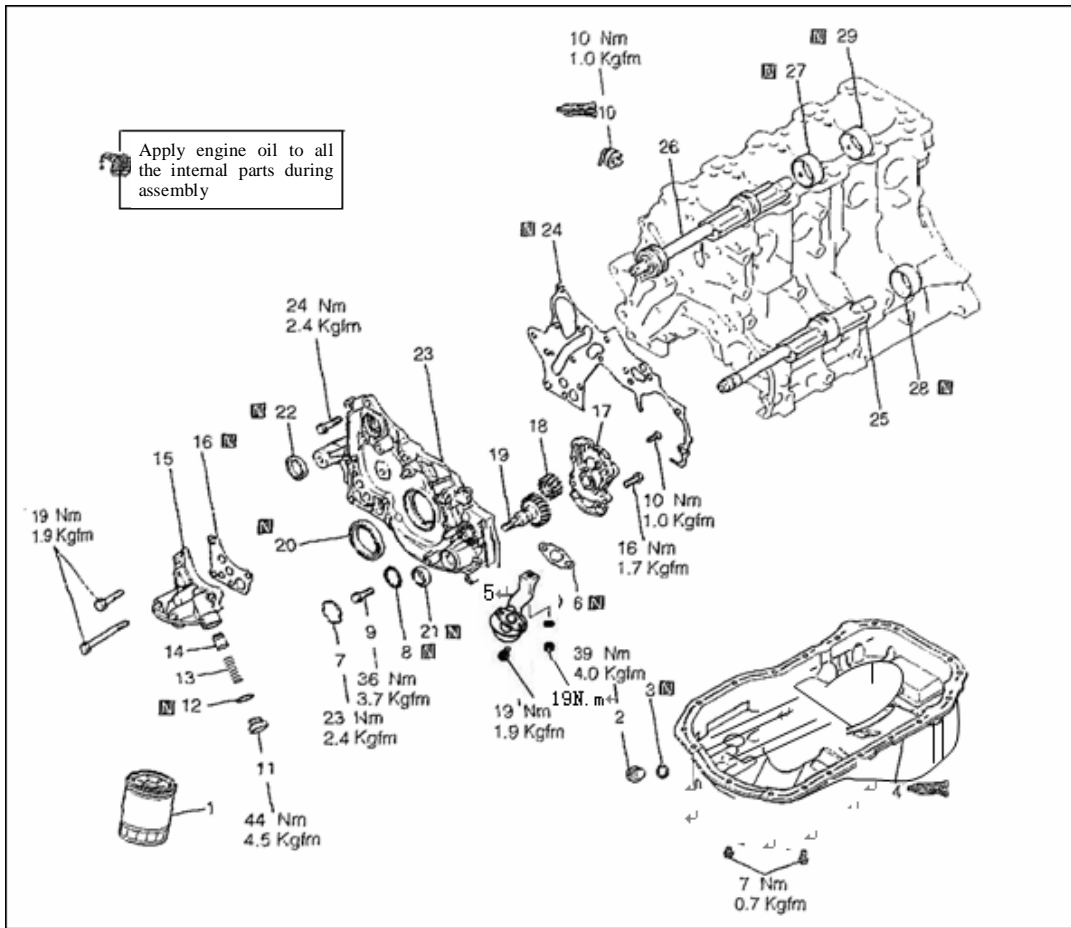
- (3) Install the valve pipe by pressing until its protrusion meets the requirement.

**Standard value: 14mm±0.3**

### Caution:

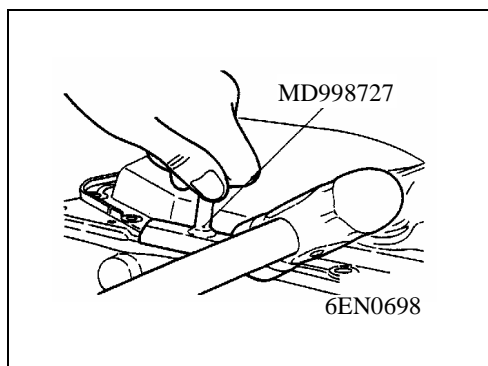
- Press down the valve pipe from the cylinder head top.
  - Inlet valve pipe and exhaust valve pipe are different in length.  
(Inlet valve: 45.5, Exhaust valve: 50.5)
- (4) After installation of the valve pipe, insert a new valve, and check for smooth movement.

## Front Cover, Oil Pump, Balance Shaft and Sump



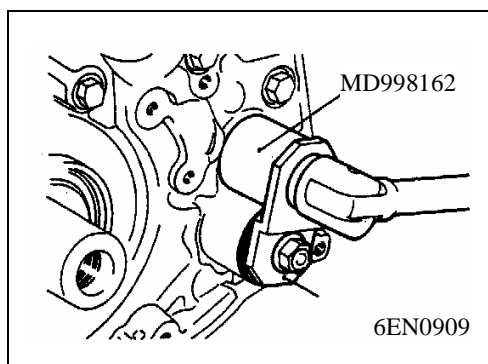
### Removal Steps

- |                              |                                       |
|------------------------------|---------------------------------------|
| 1. Oil filter                | 16. Oil filter rack pad               |
| 2. Drain plug                | 17. Oil pump cover                    |
| 3. Drain plug pad            | 18. Oil pump driven gear              |
| 4. Sump                      | 19. Oil pump driving gear             |
| 5. Suction strainer          | 20. Crankshaft front seal             |
| 6. Suction strainer pad      | 21. Oil pump seal                     |
| 7. Plug                      | 22. Balance shaft front cover         |
| 8. O ring                    | 23. Front cover                       |
| 9. Flange bolt               | 24. Front cover pad                   |
| 10. Oil pressure cock        | 25. Left balance shaft                |
| 11. Pressure release plug    | 26. Right balance shaft               |
| 12. Seal pad                 | 27. Right balance shaft front bearing |
| 13. Pressure release spring  | 28. Left balance shaft bearing        |
| 14. Pressure release plunger | 29. Right balance shaft rear bearing  |
| 15. Oil filter rack          |                                       |

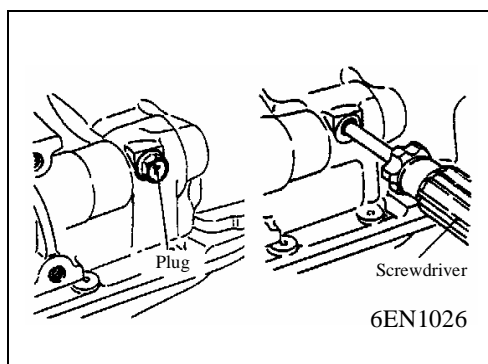
**Notice for Removal****Removal of Sump**

- (1) Remove all the sump bolts.
- (2) Hammer the special tool between the cylinder block and the sump.

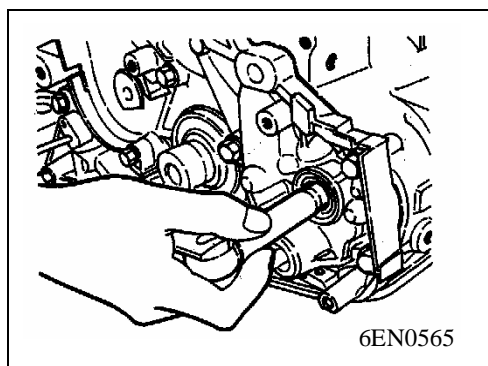
**Note:** It is prohibited to use screwdriver or chisel instead of the special tool. Otherwise the sump edge is deformed, resulting in oil leakage.

**Removal of Plug**

- (1) If the plug is too tight, tap the plug head twice or thrice with hand hammer so that the plug is loosened easily.

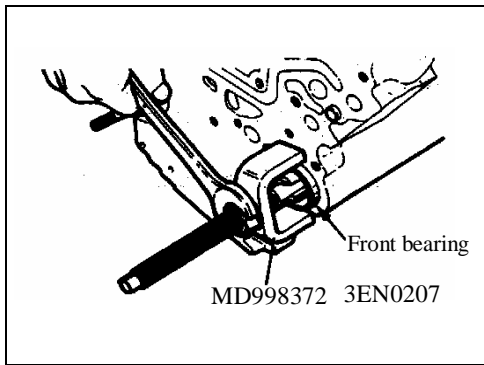
**Removal of Flange Bolt**

- (1) Remove the plug from the side of cylinder block.
- (2) Insert a cross-head screwdriver (in stem diameter of 8mm) into the plug hole to lock the balance shaft.



- (3) Loosen the flange bolt.

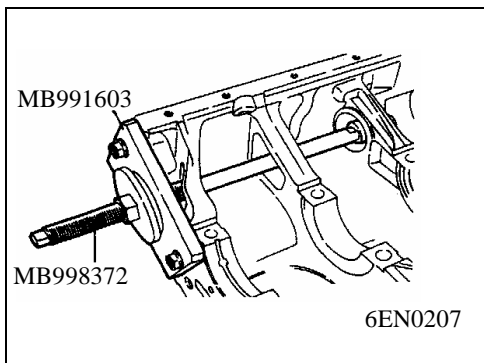




### Removal of Front Bearing of Right Balance Shaft

- (1) By using the special tool, remove the right front bearing of the balance shaft from the cylinder block.

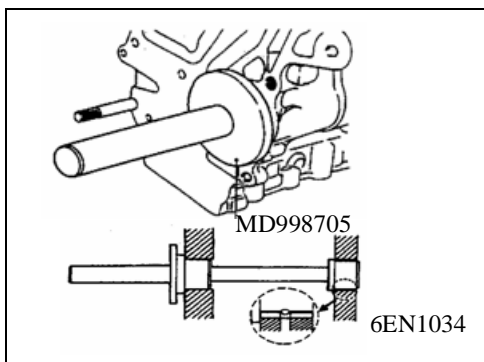
**Note:** The front bearing must be removed first. If not, the rear bearing puller can not be used.



### Removal of Rear Bearing of Balance Shaft

- (1) By using the special tool, remove the rear bearing of the left balance shaft from the cylinder block.

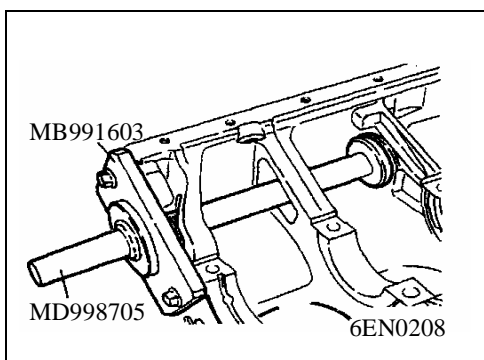
**Note:** When the rear bearing of the left balance shaft is removed, install the special tool (MB991603) in front of the cylinder block.



### Notice for Installation

#### Installation of Rear Bearing of Right Balance Shaft

- (1) Apply oil on the external face of the bearing.
- (2) By using the special tool, install the right rear bearing. Make sure that the oil hole in the bearing is aligned to that in the cylinder block.

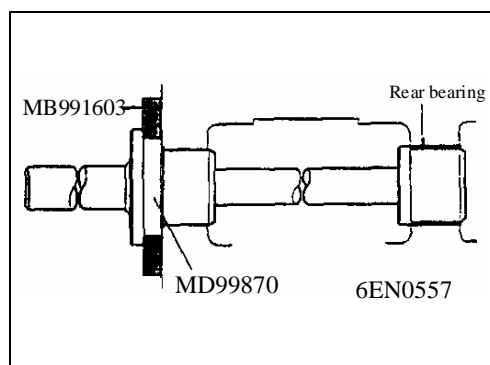


#### Installation of Rear Bearing of Left Balance Shaft

- (1) Install the special tool (guide plate) onto the cylinder block.
- (2) Apply oil to the exterior of the rear bearing and the bearing hole of the cylinder block.

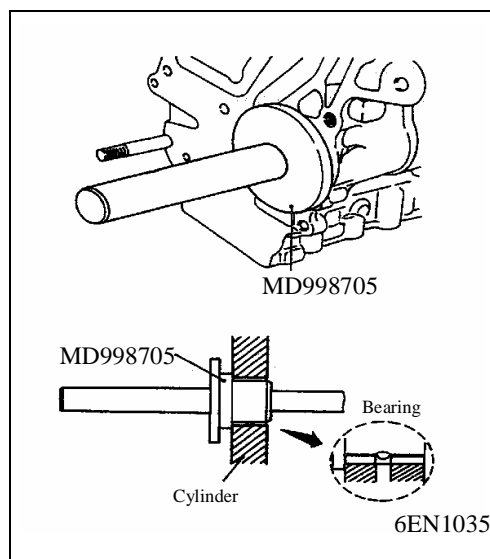
- (3) By using the special tool, install the rear bearing.

**Note:** There is no oil hole in left rear bearing.



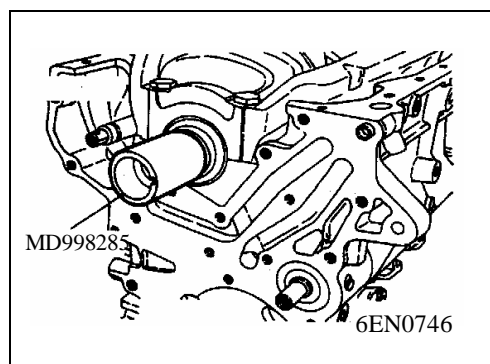
### Installation of Front Bearing of Balance Shaft

- (1) By using the special tool, install the front bearing.

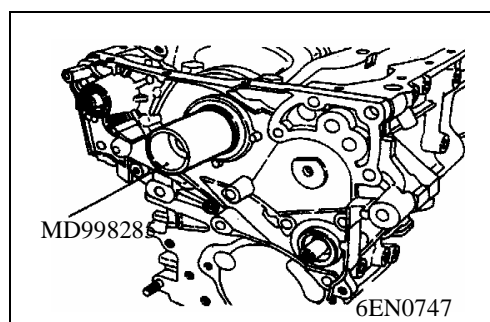


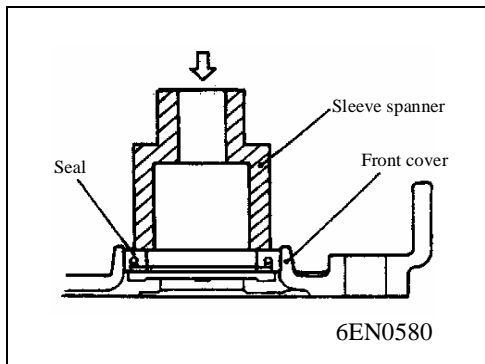
### Installation of Front Cover

- (1) Install the special tool onto the front end of crankshaft, apply a thin layer of oil to the exterior of the special tool, and then install the upper front cover.



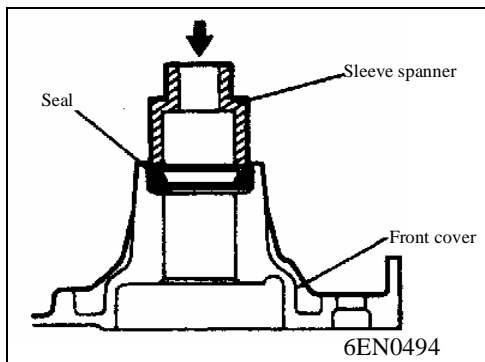
- (2) Use new front cover seal pad, install the front cover assembly, and temporarily tighten the flange bolts (with exception of the bolts for oil filter rack).





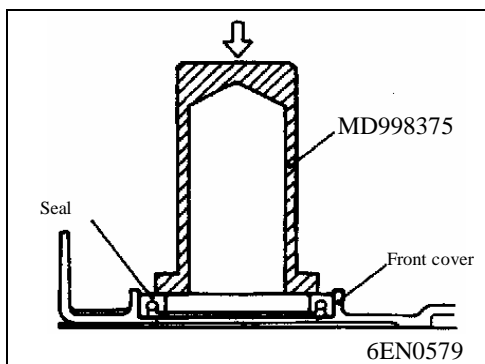
#### Installation of Balance Shaft Seal

- (1) By using a sleeve spanner, press the seal into the front cover.



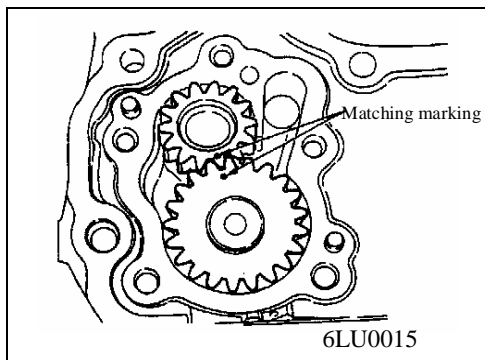
#### Installation of Oil Pump Seal

- (1) By using a sleeve spanner, press the seal into the front cover.



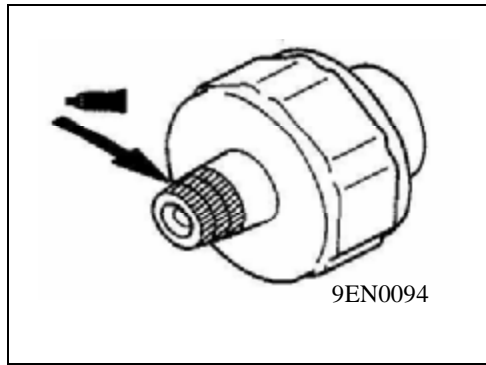
#### Installation of Crankshaft Front Seal

- (1) By using the special tool, install the crankshaft front seal onto the front cover.



#### Installation of Oil Pump Driven Gear and Oil Pump Driving Gear

- (1) Apply oil on the gear surfaces, and align the matching markings.



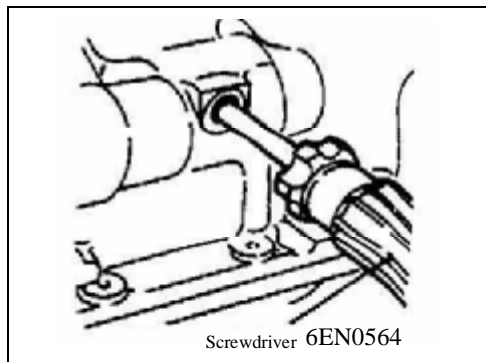
### Application of Sealant to Oil Pressure Cock

- (1) Apply sealant to the thread of the oil pressure cock, and then use the special tool to install the cock.

Designated sealant: 3M ATD No. 8660 or equivalent

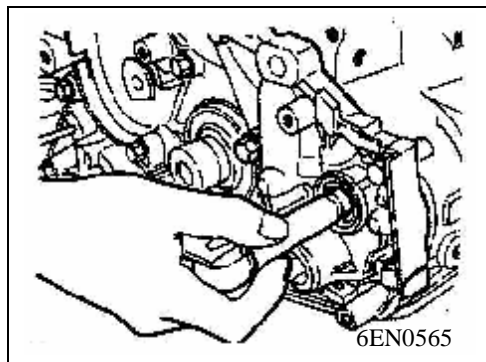
**Caution:** • The end portion of the thread must be kept clean and is not applied with sealant.

• Avoid overtightening.

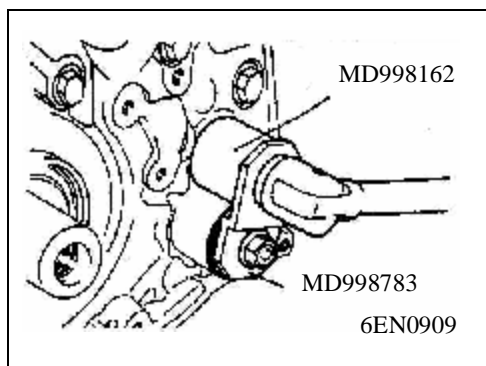


### Removal of Flange Bolt

- (1) Insert a cross-head screwdriver into the hole on the left side of the cylinder block to lock the balance shaft.

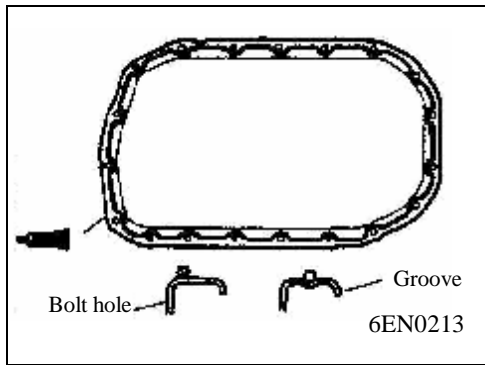


- (2) Tighten the flange bolts to the stipulated torque so as to ensure that the oil pump driven gear is fixed on the left balance shaft.



### Installation of Plug

- (1) Install a new O ring into the groove in front casing.
- (2) By using special tool, install the plug and tighten to stipulated torque.



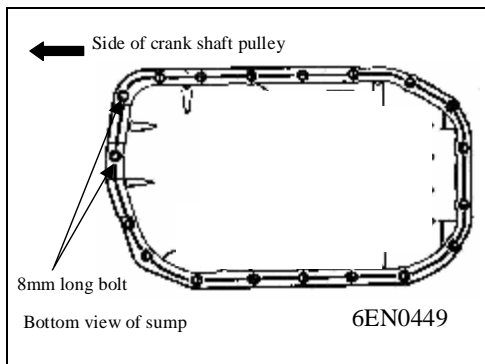
### Installation of Sump

- (1) Clean the mating surfaces of the sump and the cylinder block.
- (2) Apply the sealant squeezed out in the diameter of 4mm to the whole circumference of sump flange.

**Designated sealant: Mitsubishi Brand product MD970389 or equivalent**

#### Note:

- (1) Quickly install the sump when the sealant is still wet (about 15min).
- (2) Do not wet the sealing portion with oil within about 1h after installation.

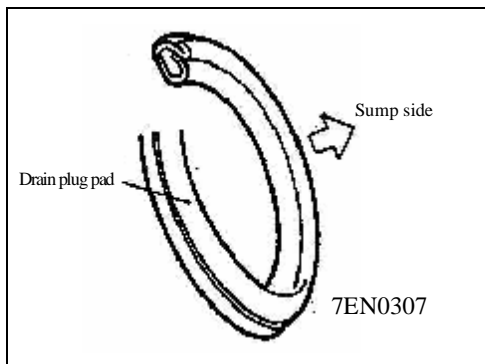


- (3) Conform the bolt length. The installation positions are different.

### Installation of Drain Plug Pad

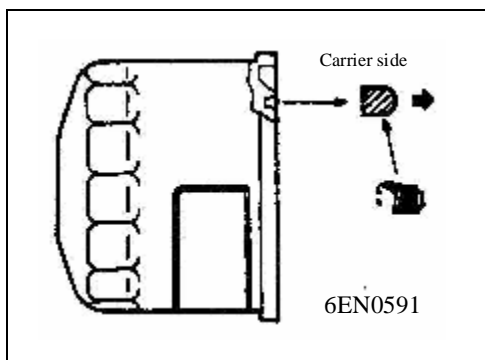
- (1) Install the drain plug pad in the direction as shown in the Fig.

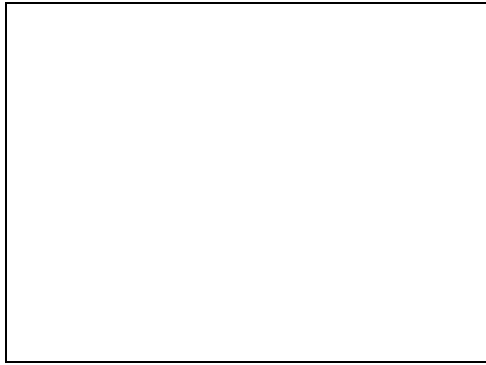
**Caution: Installation in incorrect direction may cause oil leakage.**



### Installation of Oil Filter

- (1) Clean the installation face of the oil filter rack.
- (3) Apply engine oil to the O ring of oil filter.
- (3) Screw in the oil filter, and rotate 3/4 turns more after the O ring is in contact to the installation face. (tightening torque: 1.4N.m)

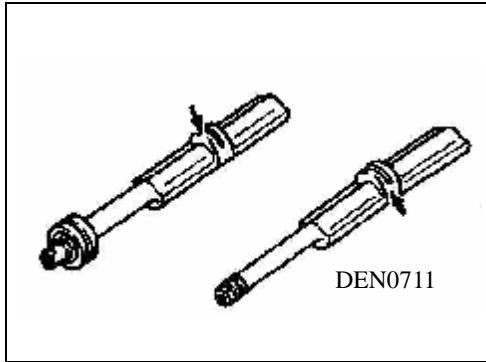




## INSPECTION

### Front Cover

- (1) Check the oil hole for blockage, and clean when necessary.
- (2) Check the front bearing of the left balance shaft for wear, damage and burn, and replace the front cover if any.
- (3) Check the front cover for crack or other damage, and replace the front cover assembly if any.



### Oil Seal

- (1) Check the seal lip for wear or damage. Replace the oil seal when necessary.
- (2) Check the seal lip for deterioration. Replace the seal when necessary.

### Balance Shaft

- (1) Check the oil hole for blockage.
- (2) Check the journal for burn, damage or bearing interference. If not satisfactory, replace the balance shaft, bearing or front cover assembly,

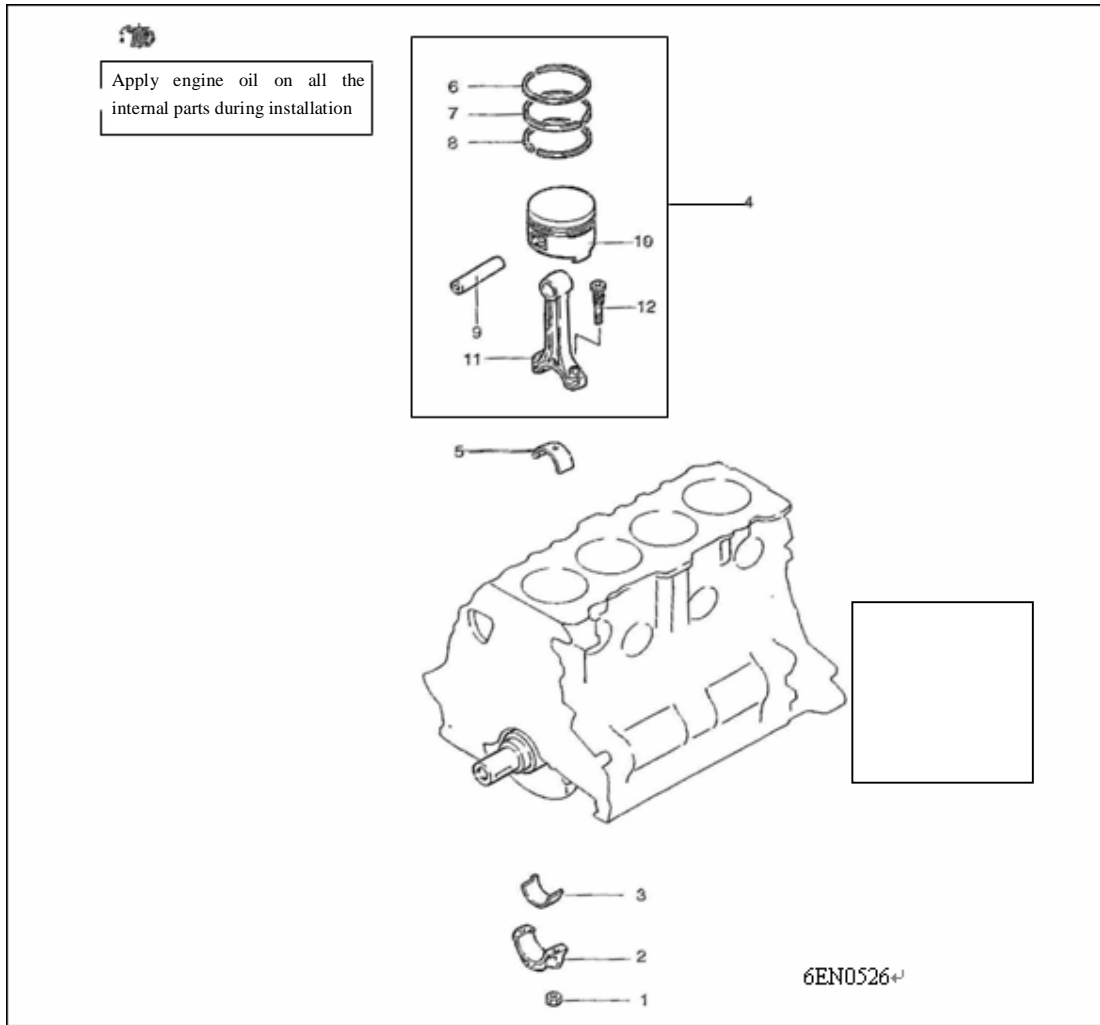
### Oil Pump

- (1) Install the oil pump gear onto the front cover, then rotate this gear and check for smooth rotation and freedom of looseness.
- (2) Make sure that there is no ridge-shaped wear on the contact faces between the front cover and the oil pump cover gear.
- (3) Check the side gap.

**Standard value: Driving gear 0.08-0.14mm**

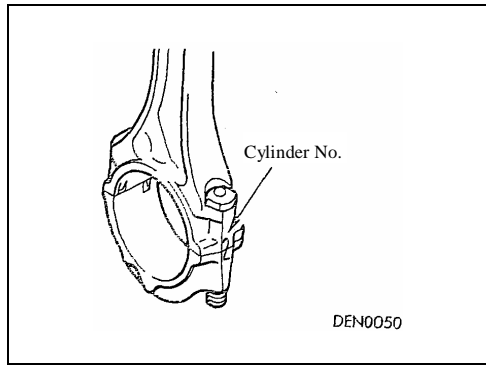
**Driven gear 0.06-0.12mm**

## Piston and Link Rod Group

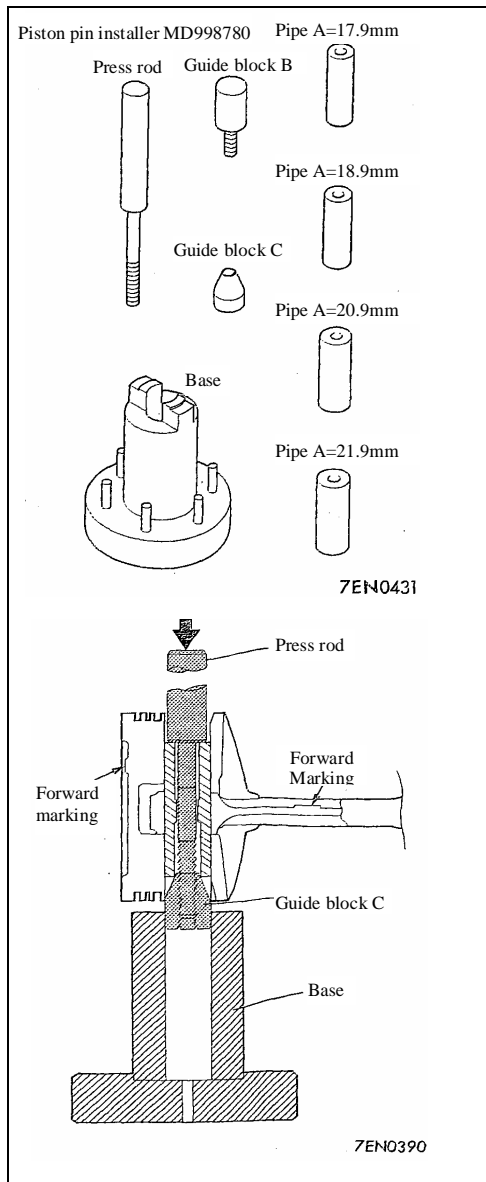


### Removal Steps

1. Link rod nut
2. Link rod cover
3. Link rod bearing
4. Piston and connecting rod assembly
5. Link rod bearing
6. No.1 compression ring
7. No.2 compression ring
8. Oil ring
9. Piston pin
10. Piston
11. Link rod
12. Link rod bolt

**Notice for Removal****Removal of Connecting Rod Cap**

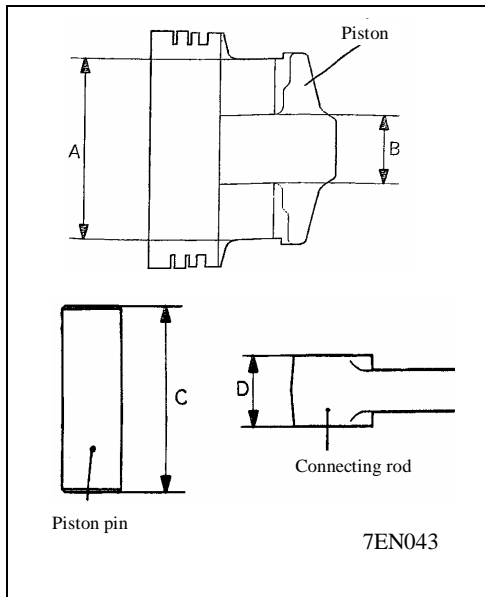
- (1) Mark the cylinder number on big end side of the connecting rod for correct assembly.
- (2) Place the removed connecting rods, connecting rod caps and connecting rod bearings in the order of the cylinder numbers.

**Removal of Piston Pin**

- (1) Insert the special tool press rod from the side marked with arrow, and install the guide block C to the press rod end.
- (2) Hold the piston facing forward and with the marking upward, and install the piston connecting rod assembly on the base of piston pin installer (special tool).
- (3) Press out the piston pin with pressure.

**Caution:** Place the disassembled pistons, piston pins and connecting rods, connecting rod caps and connecting rod bearings in the order of the cylinder numbers.





### Notice for Installation

#### Installation of Piston Pin

- (1) Measure the following dimensions of the piston, piston pin and connecting rod:

A: Length of piston pin insert hole

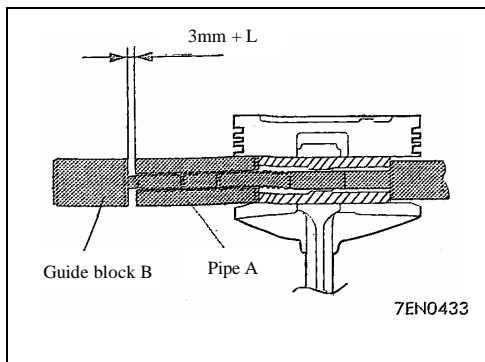
B: Width between pin seats

C: Length of piston pin

D: Width of connecting rod small end

- (2) Substitute the above measured dimensions into the following formula and calculate dimension L.

$$L = [(A - C) - (B - D)] / 2$$



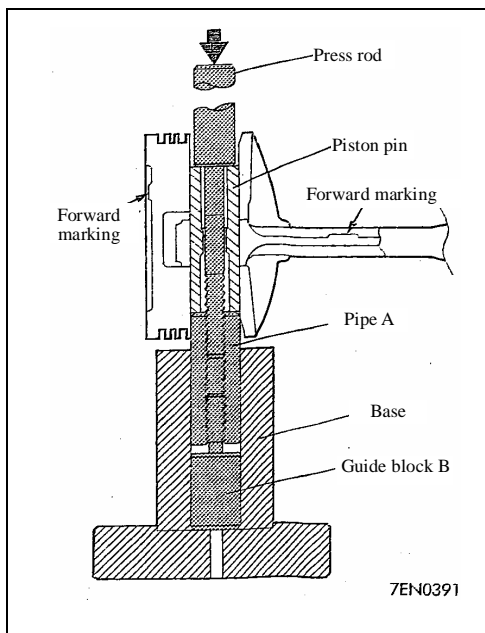
- (3) Insert the special tool press rod into piston pin, and install the pipe A to the press rod end.

- (4) Conduct assembly with the forward marking on piston and that on connecting rod in the same direction.

- (5) Apply engine oil to the outer diameter of piston pin.

- (6) Assemble the piston pin, press rod and pipe assembly according to Step (3), and insert pipe A end into the piston pin hole from the side of the forward marking.

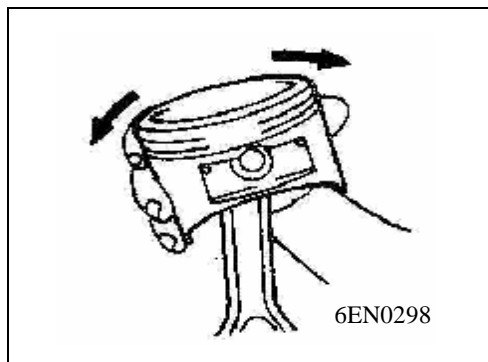
- (7) Screw in guide block B into guide pipe A to enable the gap value between guide block B and guide pipe A is the value L obtained in Step (2) plus 3mm.



- (8) Hold the piston with forward marking upward, and install the piston connecting rod assembly on the base of piston pin installer (special tool).

- (9) Press in the piston pin with pressure. When the pressure is less than the standard value, Replace the piston pin and piston assembly, or/and replace the connecting rod.

**Standard value: 750 ~ 1750kg**



(10) Check the piston for free rotation.

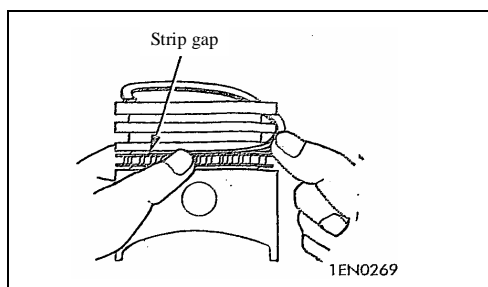
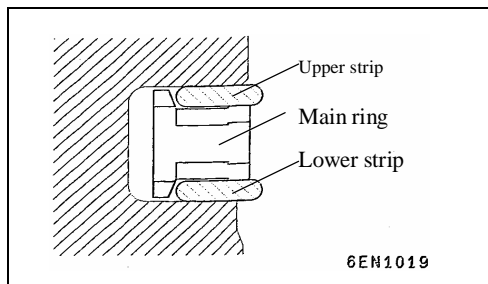
### Installation of Oil Ring

(1) Place the main ring into the oil ring groove.

**Note :** • There is no difference between the upper and lower faces of the apex seal strip and the main ring.

• The new main ring and apex seal strip are in color for identification of their dimensions.

Side	Identification Color
Standard	None
Enlarged 0.50mm	Red
Enlarged 1.00mm	Yellow



(2) Put in the upper apex seal strip. To install the apex seal strip, first press on end of the apex seal strip into the piston oil ring groove. Expansion of the apex seal strip by ring clamp may break the apex seal strip. It is different from the other piston rings.

**Caution: It is not allowed to install the apex seal strip with ring clamp.**

(3) Install the lower apex seal strip according to Step (2).

(4) After installation of the apex seal strip, check it for free rightward and leftward rotation.

### Installation of No. 1 Compression Ring and No.2 Compression Ring

(1) By using the ring clamp, install No. 2 compression ring first and then No. 1 compression ring.

**Note:** • There is Identification marking at the ring end.

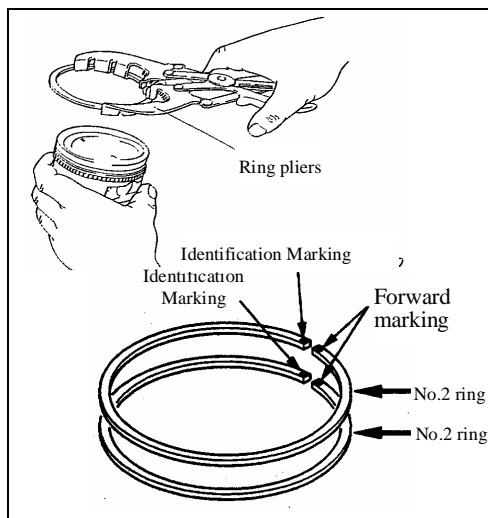
**Identification marking: No. 1 ring .....1R**

**No.2 ring .....2R**

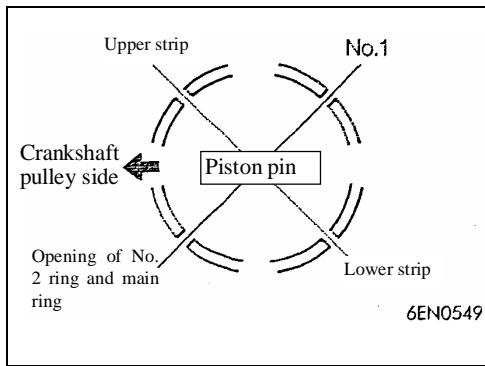
• Install the piston ring with the Identification marking upward and facing the piston top.

• The dimensions markings of piston rings are listed in the following table:

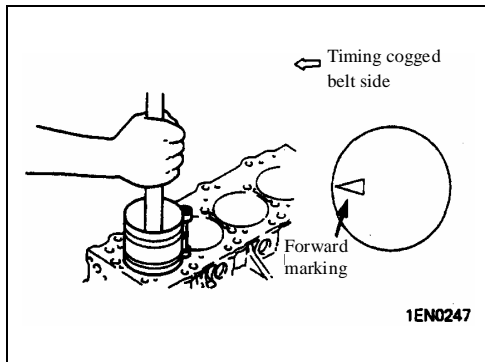
Side	Dimension Marking
Standard	None
Enlarged 0.50mm	50
Enlarged 1.00mm	100



### Installation of Piston and Connecting Rod Assembly



- (1) Apply enough engine oil to the piston, compression ring and oil ring.
- (2) Adjust the openings of the compression ring and oil ring (apex seal strip and main ring) to the positions as shown in the Fig.
- (3) Rotate the crankshaft to position the crank pin to the cylinder hole.
- (4) Before the piston and connecting rod assembly are inserted into the cylinder block, adopt suitable thread protection device on connecting rod bolt. Care must taken not to damage the crank pin.
- (5) By using a suitable piston ring compression tool, insert the piston and connecting rod assembly into the cylinder block.



**Caution :** • The forward marking on the piston top should point to the front of engine (the side of timing cogged belt).

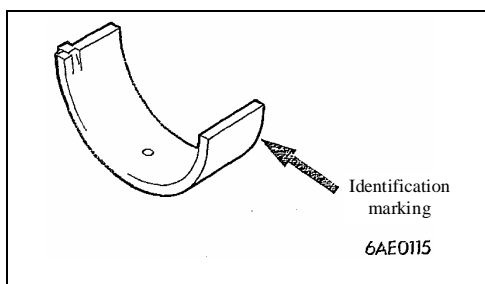
### Installation of Connecting Rod Bearing

To replace the bearing, select and install the bearing in the following steps:

- (1) Measure the outer diameter of the crank pin; determine its group number according to the following table. The crankshafts serving as the repair parts are identified with paint colors at the positions as shown in the Fig. ( )

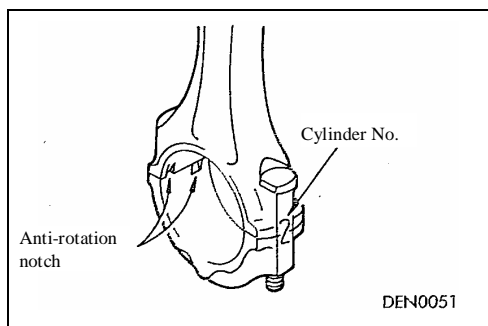
Crank Pin			Connecting rod bearing		
Group No.	Identification Color	Outer Diameter (mm)	Identification Marking	Identification Color	Thickness (mm)
I	Yellow	44.995~45.000	1	Yellow	1.487~1.491
II	None	44.985~44.995	2	None	1.491~1.495
III	White	44.980~44.985	3	Blue	1.495~1.499

**Inner diameter of connecting rod: 48.000~48.015mm**



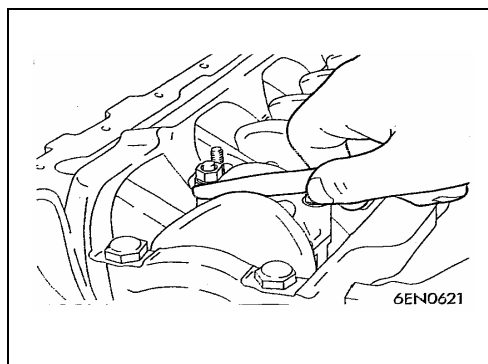
- (2) The identification marking of the connecting rod bearing is printed at the position as shown in the Fig.
- (3) Select the bearing from the above table according to the Group Nos. determined in Steps (1) and (2).

Example for Bearing Selection: If the measured value of the outer diameter of crankshaft pin is 44.996mm, it is in Group I in the above table. If the repair part is required for replacement of crankshaft, check the identification color coated on the new crankshaft pin. If the color is yellow, the crankshaft pin is in Group I. At this time, select the connecting rod bearing of which the identification marking is 1.



### Installation of Connecting Rod Cap

- (1) During installation of connecting rod cap, align the markings made in disassembly. To install the new part without any marking, make the anti-rotation notch as shown in the Fig. installed on the same side.



- (2) Check the connecting rod big end for reasonable axial gap.

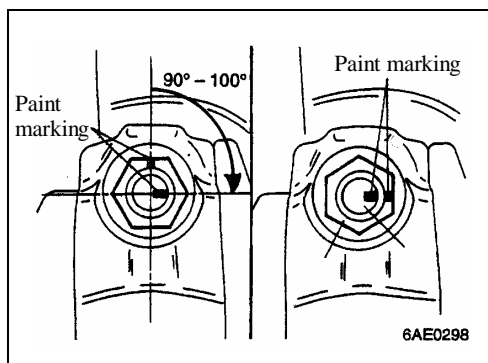
**Standard value:** 0.10~0.25mm

**Limit value:** 0.4mm

### Installation of Connecting Rod Nut

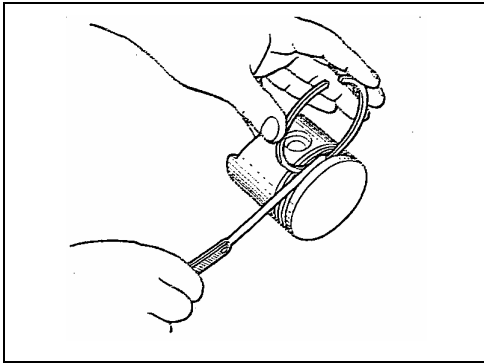
**Caution:** Before installation of the connecting rod cap, if the cylinder head is installed, remove the spark plug, and then install the connecting rod cap nut.

- (1) By adopting the tightening method in plastic range, tighten the connecting rod bolt and nut. Before the bolt is reused, check the bolt for stretching. Tighten the nut on the thread until it reaches the full length. If the nut can not be tightened smoothly to the end, it means that the thread is stretched. Replace the bolt.
- (2) Apply oil to the thread of the nut before tightening the nut.
- (3) Tighten the bolt with finger, and then tighten the nuts alternatively for correct assembly of the connecting rod cap.
- (4) Retighten the nut with 20N.m torque.
- (5) Coat paint marking on each nut head.
- (6) Make a paint marking on the bolt at the position where 90~100° in the nut tightening direction is departed from the paint marking on the nut head.
- (7) Turn the nut for 90~100° until the markings on the nut and bolt are aligned.



**Caution:** • If the tightening angle is less than 90°, the stipulated tightening performance can not be ensured. Therefore, pay attention the tightening angle when tightening.

• If the nut is tightened excessively (more than 100°), loosen the bolt fully, and then repeat the tightening from Step (1).



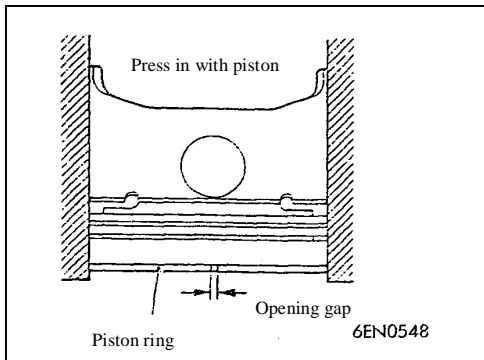
## INSPECTION

### Piston Ring

- (1) Check the piston ring for damage, excessive wear and break, and if any replace. If the piston is replaced, the piston ring must be replaced.
- (2) Check the gap between the piston ring and the piston ring groove. If the gap is too big, replace piston ring or the two.

**Standard value:** 0.02~0.06mm

**Limit value:** 0.1mm



- (3) Put the piston ring into the cylinder, correctly position it by using its piston top surface and measure the opening gap with feeler. Replace the piston ring if the opening gap is excessive.

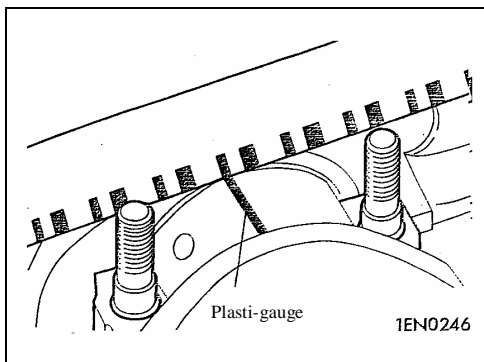
**Standard value:** No. 1 ring .....0.25~0.35mm

No.2 ring ... .....0.40~0.55mm

Oil ring..... 0.10~0.40mm

**Limit value:** No. 1 ring and No. 2 ring ...0.8mm

Oil ring..... ...1.0mm



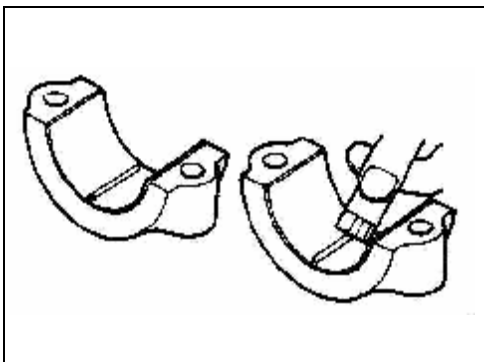
### Gap of Crank Pin (Plasti-gauge)

- (1) Clean the connecting rod journal and the connecting rod bearing with oil.
- (1) Cut the plasti-gauge into the length the same as the bearing width, and then place it on the crank pin parallel to the central line of the shaft.

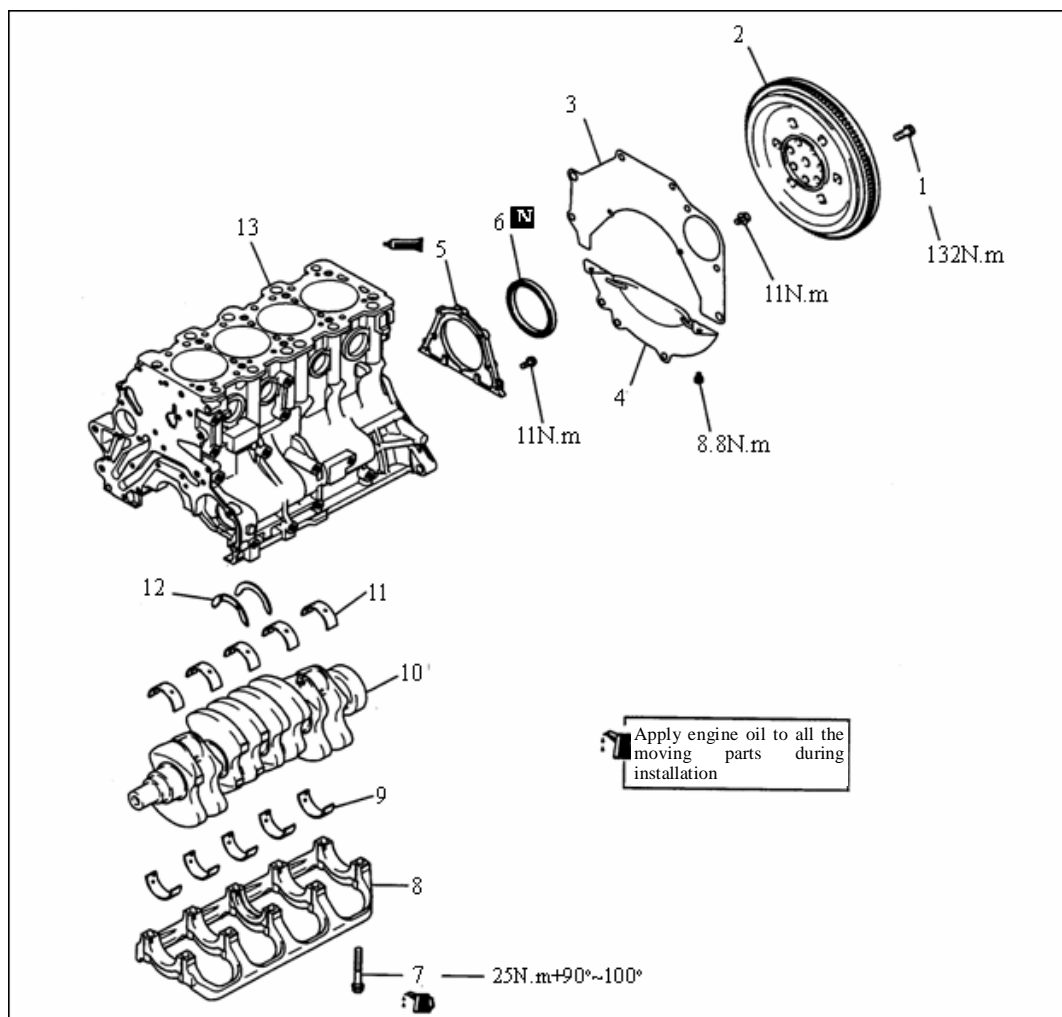
- (3) Carefully install the connecting rod cap, and tighten the nut to stipulated torque.
- (4) Carefully remove the connecting rod cap.
- (5) By using the ruler printed on the plasti-gauge packing, measure the width at the widest portion of flatted plastic line and obtain the gap value.

**Standard value:** 0.02~0.05mm

**Limit value:** 0.1mm

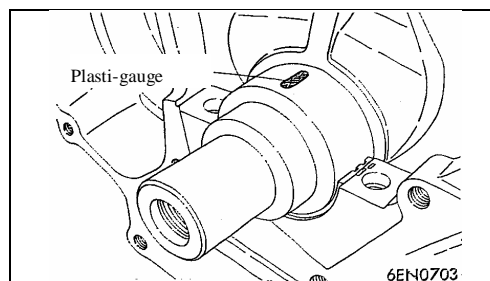


## Crankshaft, Cylinder Block and Flying Wheel



### Removal Steps

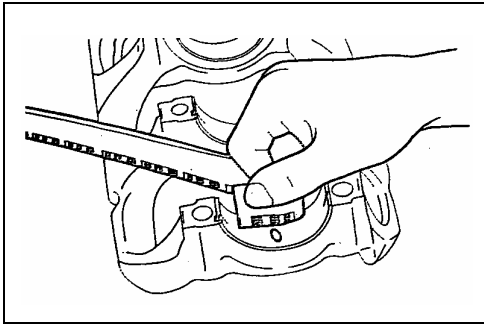
1. Flying wheel bolt
2. Flying wheel
3. Rear cover plate
4. Bell house
5. Rear seal cover
6. Oil Seal
7. Main bearing cover bolt
7. Main bearing cover
8. Crankshaft lower bearing
9. Crankshaft
10. Crankshaft upper bearing
11. Crankshaft thrust bearing
12. Cylinder block



### INSPECTION

#### Measurement of Crankshaft Pin Gap (Plasti-gauge)

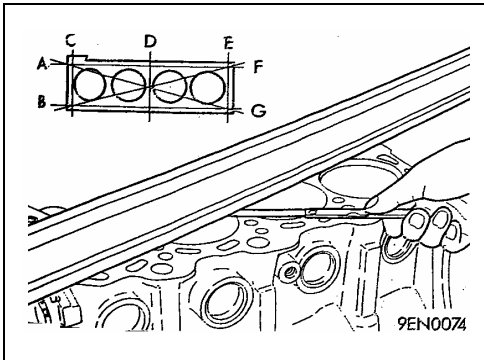
- (1) Wipe clean the oil from the main journal and the inner diameter of bearing.
- (2) Install the crankshaft.
- (3) Cut the plasti-gauge into the length the same as the bearing width, and then place it on the crank pin parallel to the central line of the shaft.
- (4) Carefully install the main bearing cover, and tighten the bolt to stipulated torque.



- (5) Carefully remove the main bearing cover.
- (6) By using the ruler printed on the plasti-gauge packing, measure the width at the widest portion of flatted plastic line and obtain the gap value.

**Standard value : 0.02~0.04mm**

**Limit value : 0.1mm**



### Cylinder Block

- (1) Visually check for scratch, rust, corrosion and other defects. Or check with flow reagent. If the defect is serious, repair or replace.
- (2) Check the plane on cylinder block for buckling with ruler and feeler, and make sure that the surface is free from chips or other foreign object.

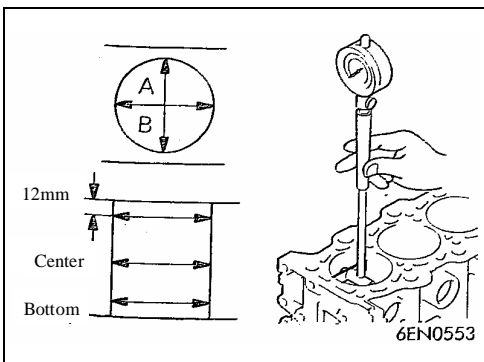
**Standard value : 0.05mm      Limit value: 0.1mm**

- (3) If the buckling is excessive, correct within allowable range, or replace.

**Lapping limit value: 0.2mm**

**Allowable wear thickness sum of Cylinder block and cylinder head: 0.2mm max.**

**Cylinder block height (new) : 290mm**



- (4) Check the cylinder wall for scratch and seize. If not satisfactory, correct (enlarge the dimensions) or replace.
- (5) Measure the inner diameter and the cylindricity of cylinder with cylinder gauge. When the wear and damage are serious, correct the cylinder by enlarging the diameter, and replace the piston and piston ring. The measurement positions are as shown in the Fig.

**Standard value: Inner diameter of cylinder 86.50~86.53mm**

**Cylindricity:  $\leq 0.01\text{mm}$**

### Boring of Cylinder Diameter

- (1) Select the enlarged piston diameter according to the max. cylinder diameter.

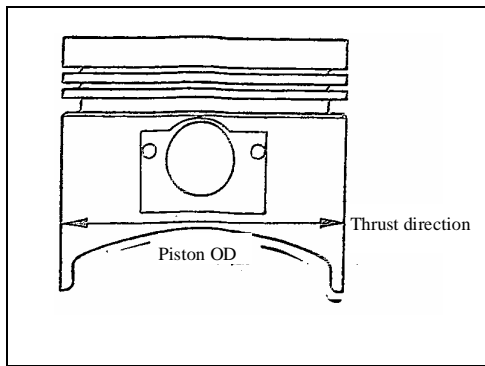
Identification of Piston Dimensions

Dimensions	Identification Marking
Enlarged 0.50	0.50
Enlarged 1.00	1.00

**Note: Dimension marking is printed on piston top.**







(2) Measure the outer diameter of the piston to be used in the thrust direction as shown in the Fig.

(3) Calculate the boring dimensions of the cylinder diameter according to the measured value of the outer diameter of piston.

**Boring dimension = Outer diameter of piston + Gap between piston and cylinder ) - 0.02 mm (honing amount)**

(4) Bore the cylinder diameter to its boring dimension.

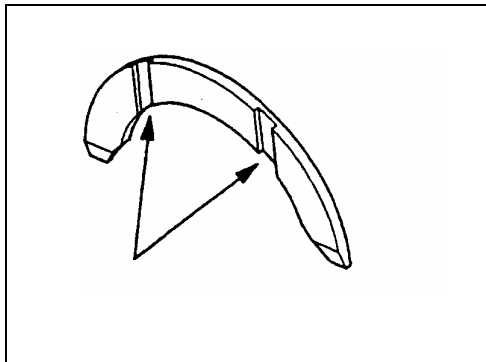
**Caution: To avoid the temperature rise from causing error during cylinder boring, process in the following steps: No.2 → No.4 → No.1 → No.3**

(5) Hone to the last cylinder diameter (Piston diameter + Gap between piston and cylinder).

(6) Check the gap between the piston and the cylinder.

**Standard value: 0.02 ~ 0.04mm**

Note: • During cylinder boring, the 4 cylinders must be bored to a same enlarged dimension, and it is not allowed to bore-enlarge the dimension of only one cylinder.

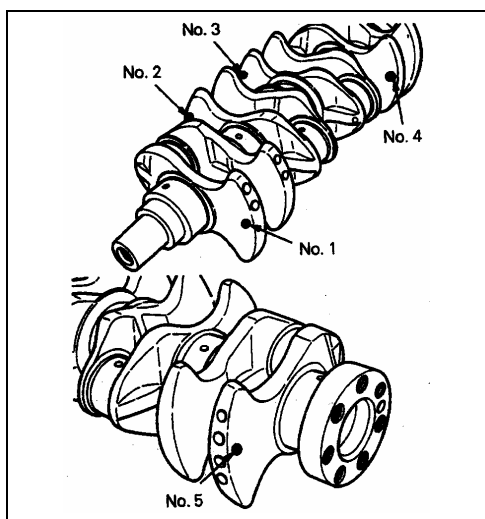


#### Notice for Installation

##### Installation of Crankshaft Thrust Bearing

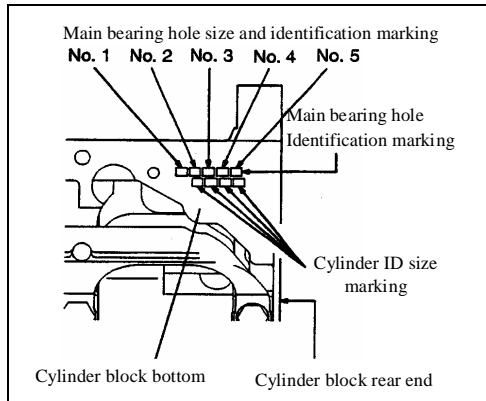
(1) Install the crankshaft thrust bearing (2 pieces) to No. 3 main shaft hole of cylinder block. Apply a bit of oil to the thrust bearing surface for convenience of installation.

(2) The grooved side of the thrust bearing must face the crankshaft crank arm.

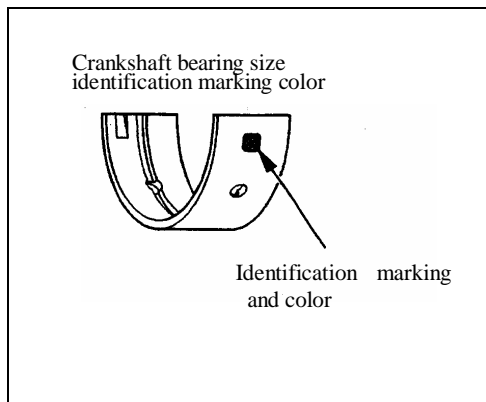


##### Installation of Crankshaft Bearing

(1) Select the bearing of which the dimension is in conformity to the crankshaft main journal according to the following table.

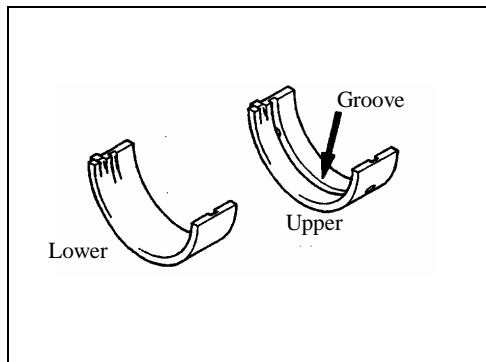


Crankshaft main journal and main shaft bore assembly			Identification Marking and Color of Nos. 1, 2, 4 and 5 Journal Bearings	Identification Marking and Color of No. 3 Journal Bearing
Group No.	Identification Color	Outer Diameter (mm)		
I	Yellow	56.994—57.000	0	0 Black
			1	1 Green
			2	2 Yellow
II	None	56.988—56.994	0	1 Green
			1	2 Yellow
			2	3 None
III	White	56.982—56.988	0	3 None
			1	4 Blue
			2	5 Red

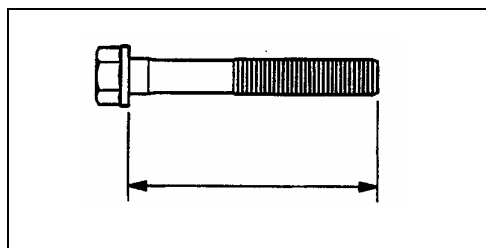


### Example for Bearing Selection

- If the identification color of crankshaft main journal is "Yellow" and the identification marking of the main shaft bore is "1", select Nos.1, 2, 4 and 5 bearings with identification marking of "2" and identification color of "Yellow" and N0.3 bearing with identification marking of "1" and identification color of "Green".
- If there is no painted identification color on the crankshaft, measure the main journal and select the bearing in the corresponding group according to the measured value.



- (2) Install the bearing with groove on the side of cylinder block.
- (3) Install the bearing without groove on the side of main bearing cover.

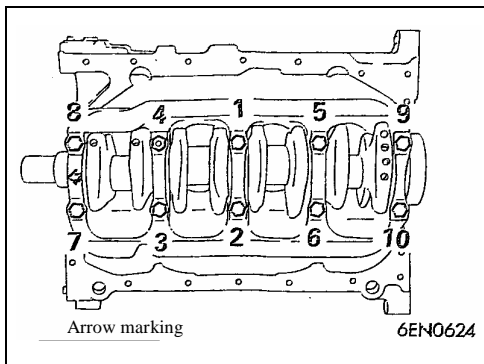


### Installation of Bearing Cover and Main Bearing Cover

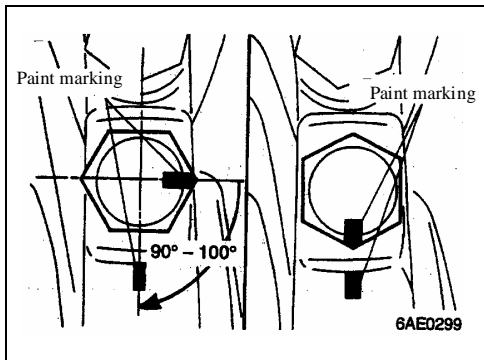
- (1) Install with the arrow on main bearing cover facing the side of timing cogged belt.
- (2) Before tighten the main bearing cover bolt, make sure that the bolt length is less than the limit value. If the length is more than the limit value, replace the bolt.

**Limit value (A): 71.1mm**

- (3) Apply oil to the thread and the seat face of the bolt.



- (4) Retighten the main bearing cover bolts with 25N.m torque in the stipulated order.



- (5) Coat paint marking on the nut head.

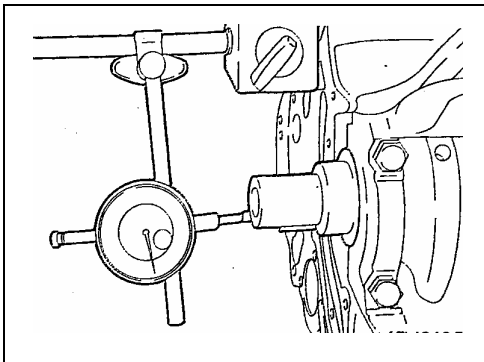
- (6) Make a paint marking on the main bearing cover at the position where 90 ~ 100° in the bolt tightening direction is departed from the paint marking on the bolt.

- (7) Tighten all the bolts for 90 ~ 100° in the order given in the Fig. until the paint markings on the bolts are aligned to that on the main bearing cover.

**Caution:**

- If the tightening angle is less than 90°, the stipulated tightening performance can not be ensured. Therefore, pay special attention to the tightening angle when tightening.

- If the nut is tightened excessively (more than 100°), loosen the bolt fully, and then repeat the tightening from Step (1).

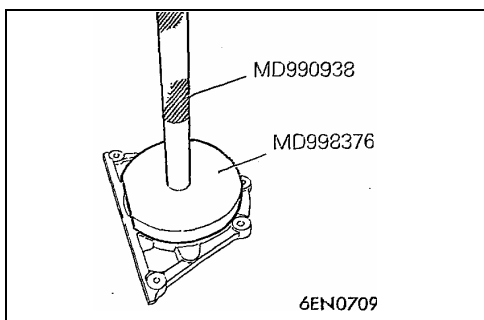


- (8) After the main bearing cover is installed, make sure that the crankshaft rotates freely and check the axial gap.

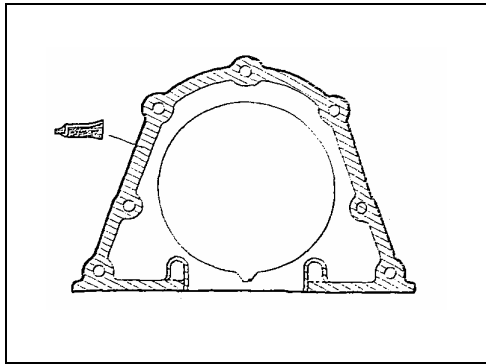
If the axial gap exceeds the used limit value, replace NO.3 crankshaft thrust bearing.

**Standard value: 0.02~0.18mm**

**Limit value: 0.25mm**



#### Installation of Oil Seal



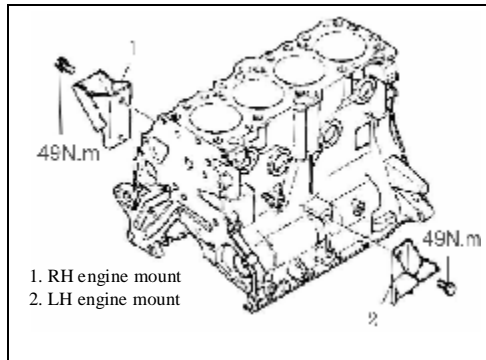
### Installation of Rear Seal Cover

Designated Sealant:

Brand: Mitsubishi Brand product MD970389 or equivalent

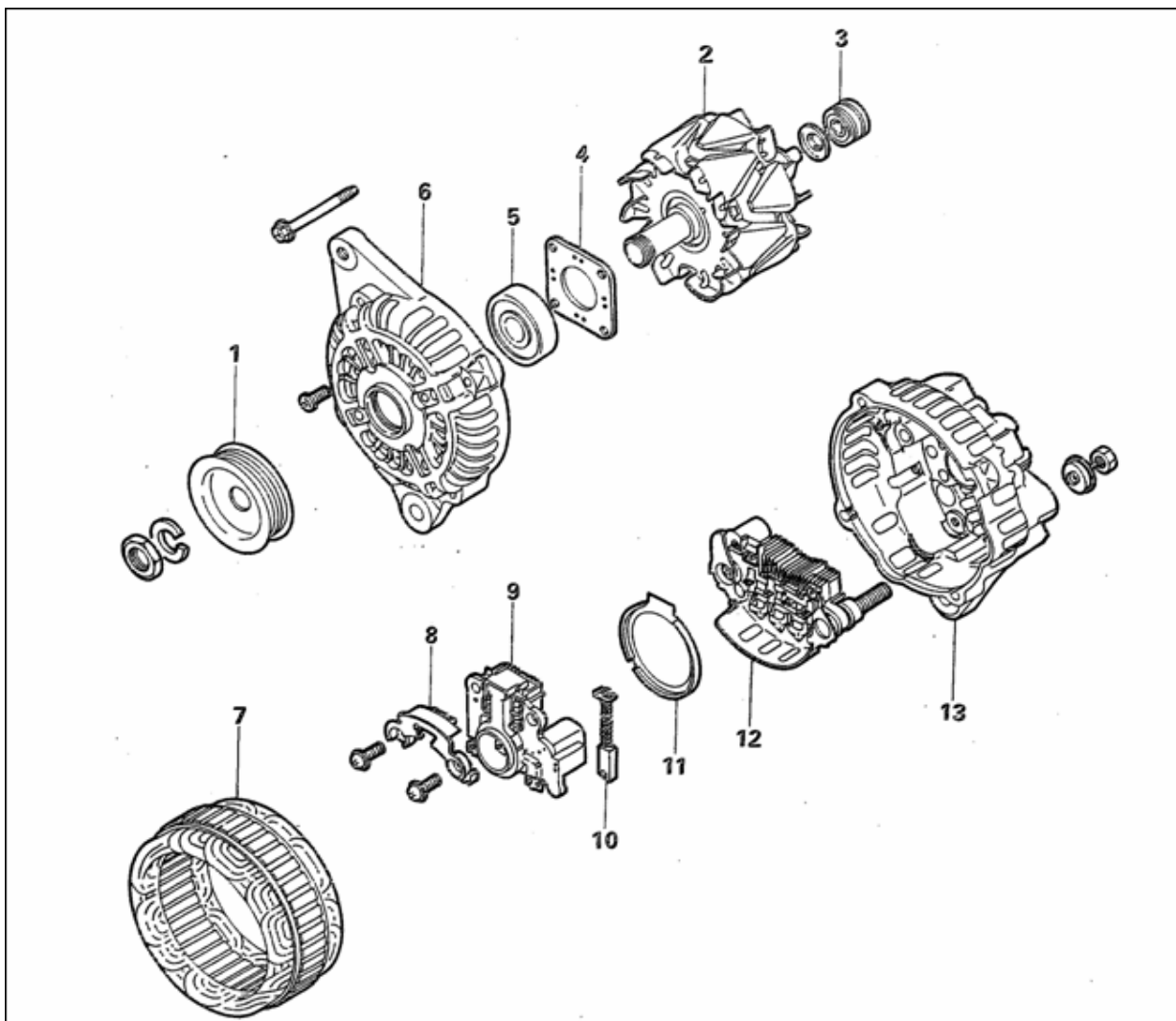
Caution: • Quickly install the rear seal cover when the sealant is wet ( $\leq 15$ min).

• After installation, keep the sealed portion far away from oil and coolant about 1h.



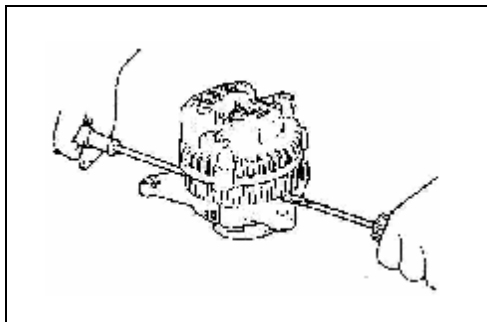
### Engine Mount

## AC Generator



### Removal Steps

- |                          |                               |
|--------------------------|-------------------------------|
| 1. Generator belt pulley | 8. Fixing plate               |
| 2. Rotator assembly      | 9. Regulator and brush holder |
| 3. Rear bearing          | 10. Brush                     |
| 4. Bearing seat          | 11. Ring                      |
| 5. Rear bearing          | 12. Commutator assembly       |
| 6. Front cover           | 13. Rear cover                |
| 7. Stator assembly       |                               |

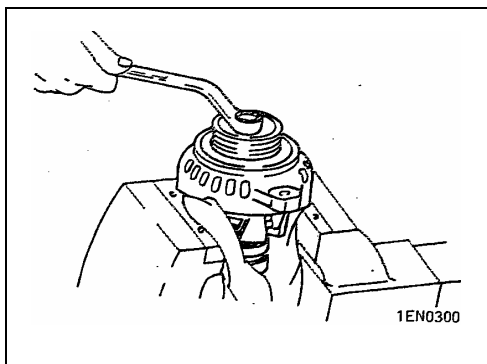


### Notice for Disassembly

#### Separation of Stator and Front Cover

- (1) Insert a screwdriver into the gap between the front cover and the stator to separate them.
- (2) If it is difficult to separate them, gently tap the front cover with plastic hammer and the same time prize with screwdriver.

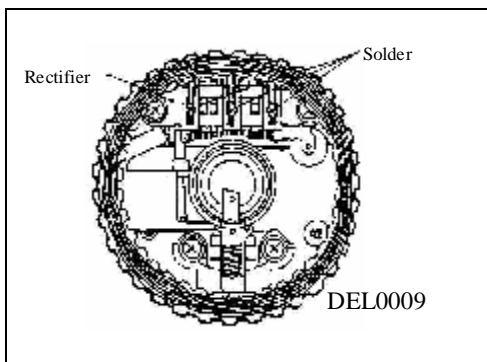
**Caution:** Do not insert the screwdriver too deep to prevent the stator coil from being damaged.



### Removal of Generator Belt Pulley and Fan

- (1) Place the belt pulley end upward, fix the rotator with vice and remove the belt pulley.

**Caution:** Do not damage the rotator.



### Removal of Stator Assembly and Regulator and Brush Holder

- (1) Remove the stator with electric soldering iron (180~250W). This operation should be completed within 4sec to avoid heat from being transmitted to the diode.
- (2) When removing the commutator from the regulator, solder off the commutator with electric soldering iron.

**Caution:** • Ensure that the heat generated by the electric soldering iron is not transmitted to the diode for a long time.

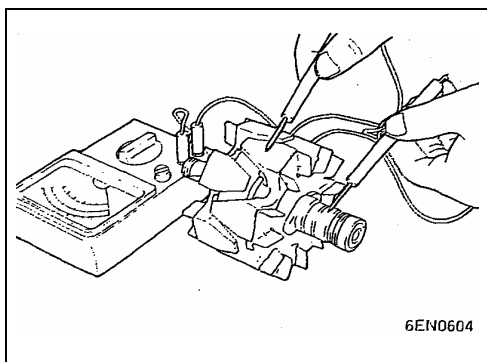
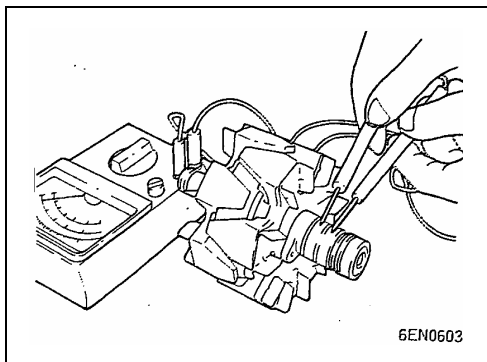
• Take care not to apply excessive force to the diode pins.

## INSPECTION

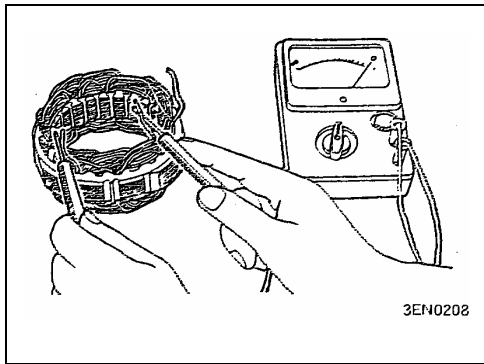
### Rotator

- (1) Check that the rotator coil is conductive, and make sure that the slide rings are conductive to each other. Measure the resistance of rotator. If the resistance is too small, it means that the rotator is short-circuited. If it is not conductive or short-circuited, replace the rotator assembly.

**Standard value:**  $3 \pm 0.5 \Omega$

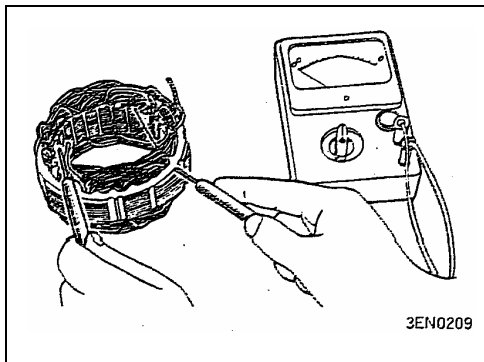


- (2) Check the rotator coil for grounding. Make sure that the slide rings and the iron core are isolated from each other. If the isolation is not satisfactory, replace the rotator assembly.

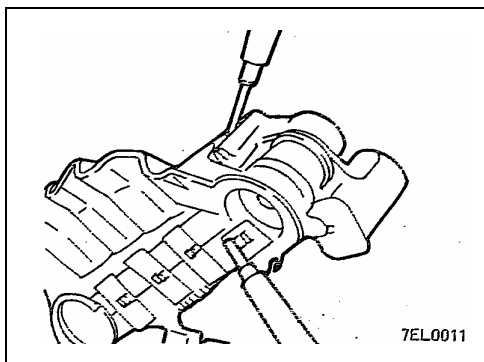


### Stator

- (1) Check that the stator is conductive, and make sure that the coil leads are conductive. If it is not conductive, replace the stator assembly.



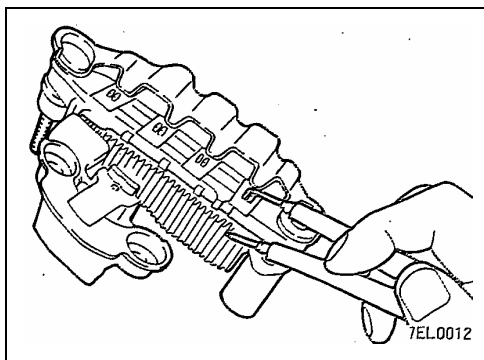
- (2) Check the coil for grounding. Make sure that the coil and the stator iron core are conductive to each other. If it is conductive, replace the stator assembly.



### Commutator

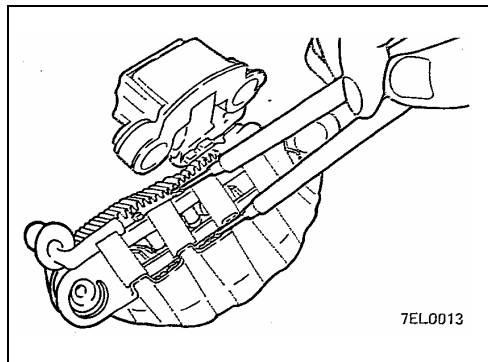
- (1) Inspection of Positive Commutator

Check with multimeter that the positive commutator and stator coil lead terminals are conductive to each other. If conduction is in two directions simultaneously, it means that the diode is broken down, replace the commutator assembly.



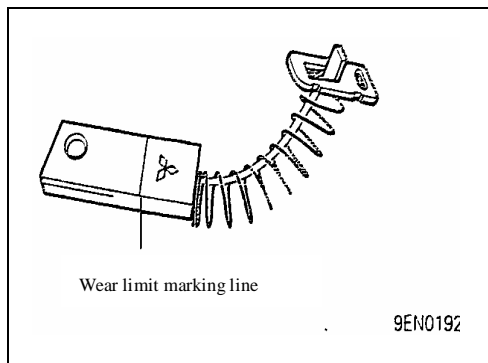
- (2) Inspection of Negative Commutator

Check that the negative commutator and stator coil lead terminals are conductive to each other. If conduction is in two directions simultaneously, it means that the diode is broken down, replace the commutator assembly.



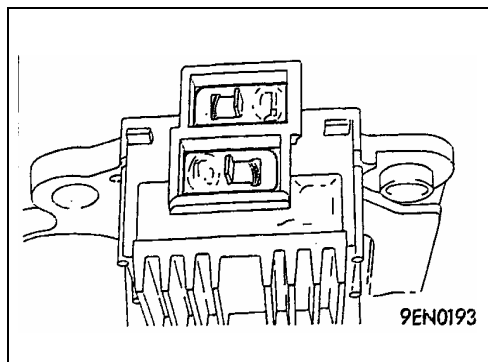
### (3) Inspection of Diode Group (3 diodes)

Connect the two end of each diode to the ammeter, and check the each of the three diodes is conductive. If no conduction is in two directions simultaneously, it means that the diode is damaged, replace the radiator assembly.

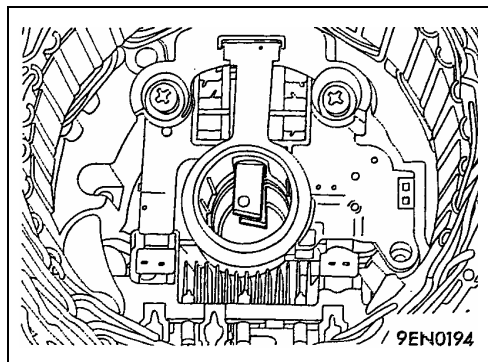


### Brush

- (1) When the brush is worn to the wear limit marking line, replace the brush in the following steps:



- (2) Solder off the brush lead from the soldering point, and take out the brush.

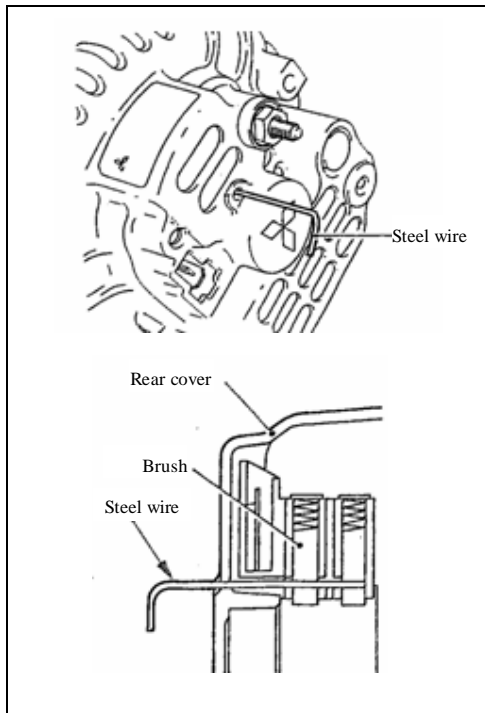


- (3) To install the new brush, solder the brush lead with brush compressed in the brush holder as shown in the Fig.

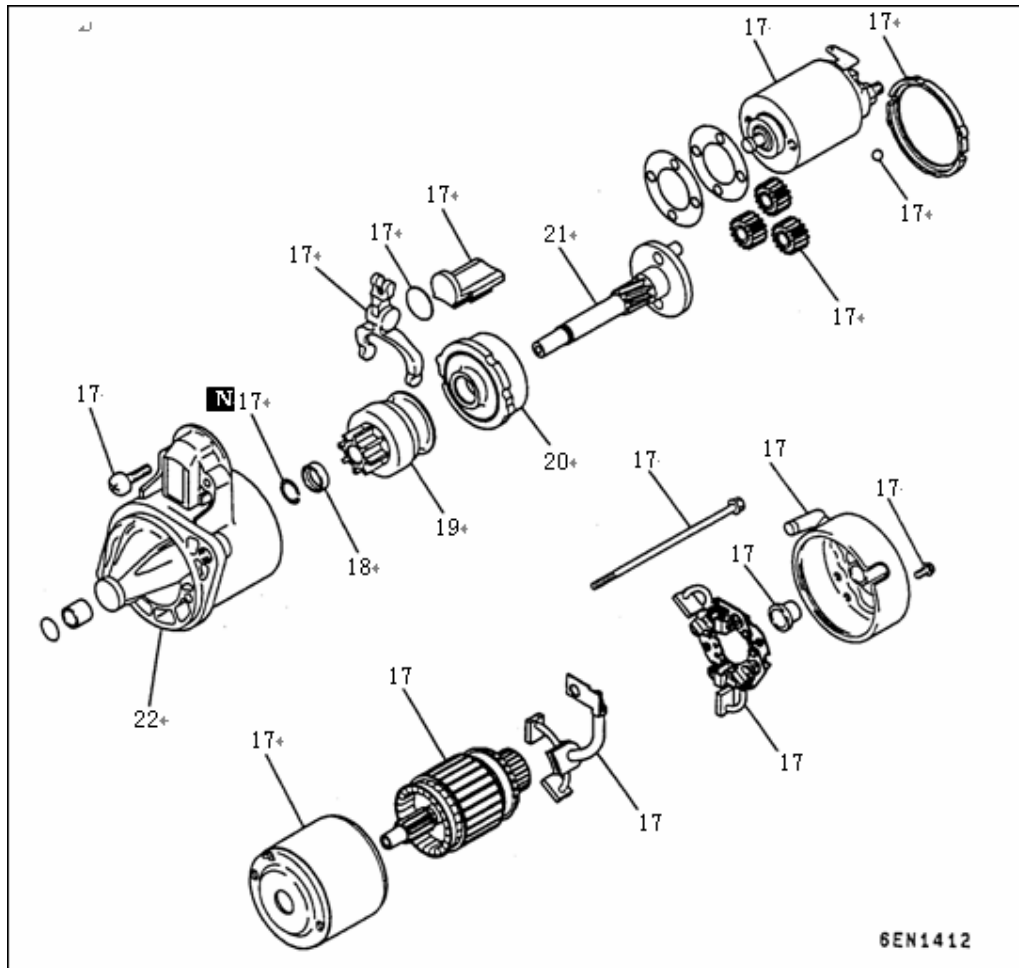


**Notice for Installation****Installation of Rotator**

Before installing the rotator on the rear cover, insert the steel wire into the small hole in the rear cover. Lift the brush and install the rotator, and pull out the steel wire.

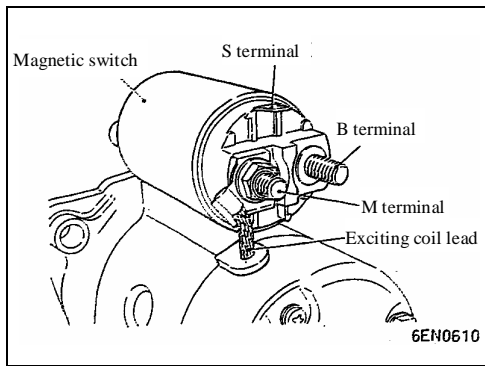


## Starter



### Removal Steps

- |                          |                          |
|--------------------------|--------------------------|
| 1. Screw                 | 13. Plate                |
| 2. Electromagnetic valve | 14. Ball                 |
| 3. Screw                 | 15. Planet gear          |
| 4. Screw                 | 16. Rod                  |
| 5. Rear rack             | 17. Clip                 |
| 6. Brush holder          | 18. Retaining ring       |
| 7. Brush                 | 19. Free-wheeling clutch |
| 8. Rear bearing          | 20. Inner gear           |
| 9. Rotator               | 21. Planet gear rack     |
| 10. Yoke assembly        | 22. Front rack           |
| 11. Washer A             |                          |
| 12. Washer B             |                          |



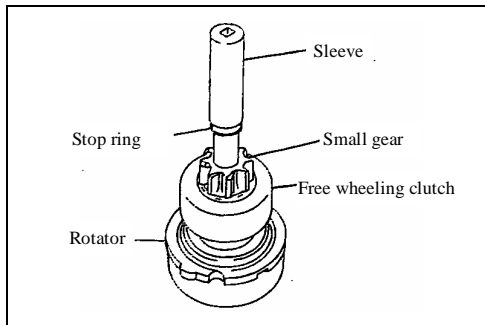
### Essentials for Disassembly

#### Removal of Solenoid Valve

- (1) Remove the exciting coil lead from M terminal of the electromagnetic valve.

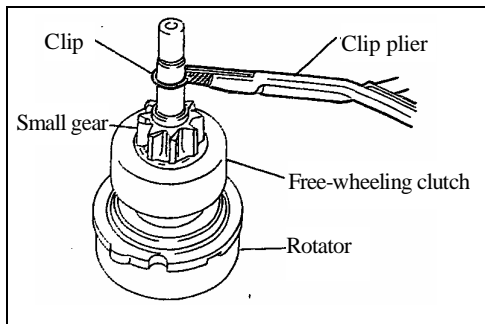
#### Removal of Rotator and Ball

- (1) During removal of the rotator, do not miss the ball at bearing end.



#### Removal of Clip and Retaining Ring

- (1) By using a suitable sleeve, push and press the retaining ring to the side of free-wheeling clutch to separate it from the clip.



- (2) By using a clip clamp, remove the clip, and then remove the retaining ring and the free-wheeling clutch.

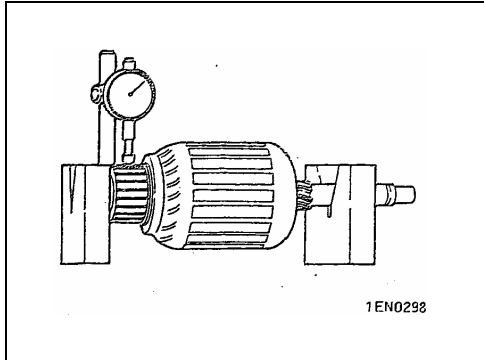
#### Cleaning of Starter Parts and Assemblies

- (1) Do not put the parts and assemblies into the cleaning agent for cleaning. Immersion of the yoke, exciting coil assembly or rotator in cleaning agent may damage their isolation.
- (2) Wipe these parts and assemblies clean with cloth if they are dirty.
- (3) It is not allowed that the drive parts are immersed in the cleaning agent. The free-wheeling clutch has been oiled before ex-work. If it is cleaned in the cleaning agent, the solution may wash away the oil in the clutch.
- (4) The drive parts may be cleaned with brush soaked with cleaning agent and then wiped dry with cloth.



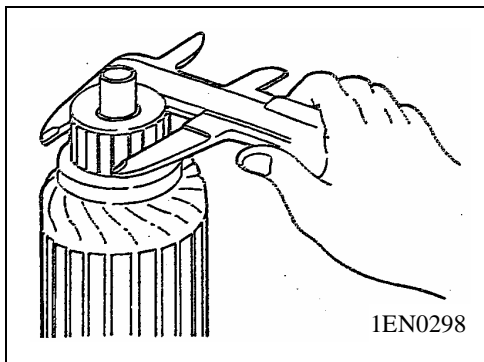
## INSPECTION

## Commutator



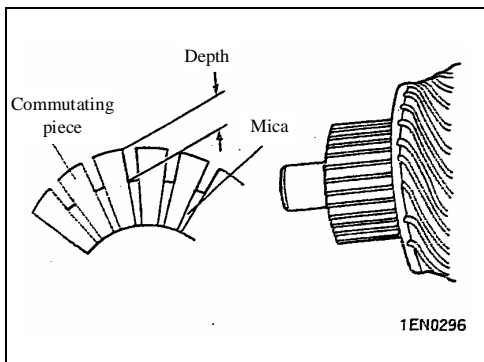
- (1) Place the rotator on a V-shaped block, and check its radial jumping with a dial gauge.

**Standard value : 0.5mm Limit value: 0.1mm**



- (2) Check the outer diameter of commutator.

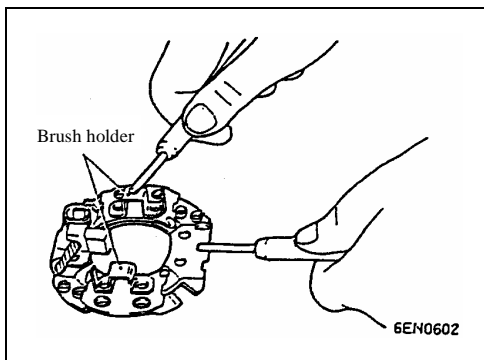
**Standard value : 29.4 mm Limit value: 28.4mm**



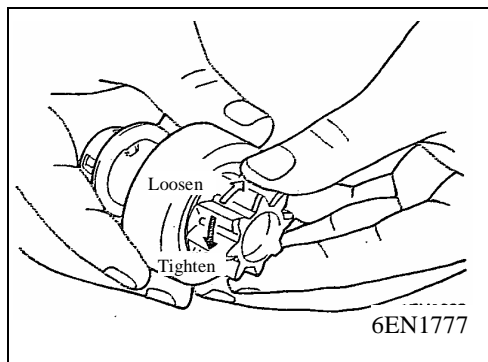
- (3) Check the sunken depth of the mica between commutator pieces.

**Standard value: 0.5mm Limit value: 0.2mm**

## Brush Holder

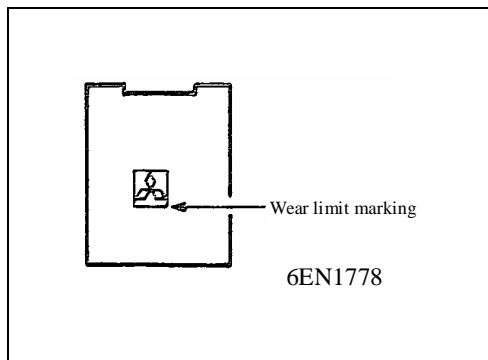


- (1) Check that the brush holder plate and the brush holder are conductive to each other. No conduction is normal.



### Free-wheeling Clutch

- (1) Make sure that the pinion gear rotates to left with resistance and to right freely.
- (2) Check the pinion gear for wear and damage.

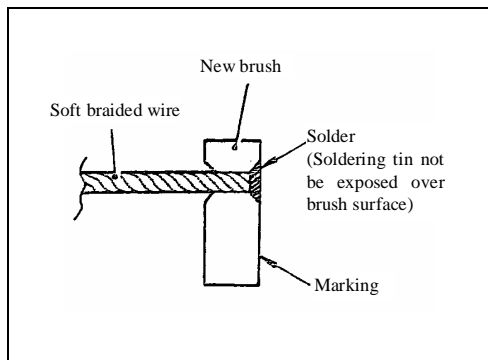


### Brush

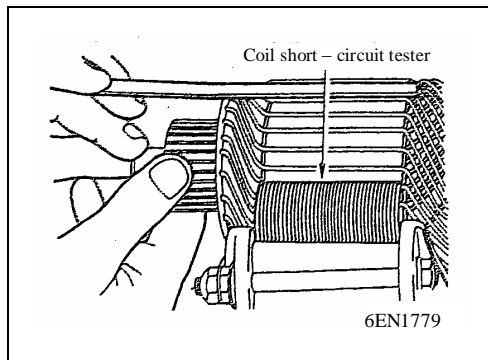
- (1) Check the roughness of the contact faces on the brush and the commutator and the length of brush.

Limit value: wear limit marking

- (2) When correcting the brush contact surface or replacing with new brush, repair with the commutator wrapped with sand paper.



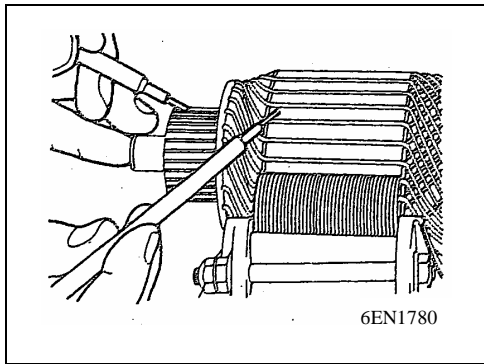
- (3) When breaking the old brush with pliers, take care not to damage the soft braided wires.
- (4) Sand the soft braided wire ends with sand paper for easy soldering.
- (5) Insert the soft braided wires into the new brush holes and solder them. Make sure that there is not solder tin exposed on the brush surface.



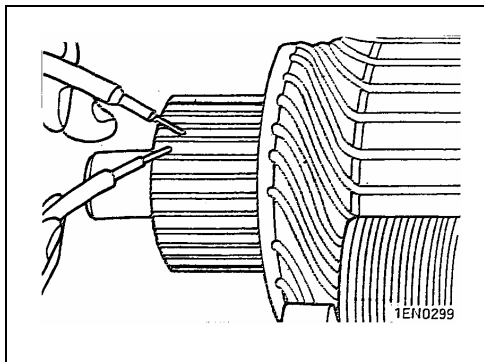
### Test of Rotator Coil Short-Circuit

- (1) Place the rotator on the coil short-circuit tester.
- (2) Place a thin iron sheet over the rotator and keep it parallel to the central shaft of the rotator, slowly rotate the rotator and observe the thin iron sheet. If the iron sheet is not attracted with any vibration, it means that the rotator is normal.

**Caution:** The test is carried out after the rotator surface is thoroughly cleaned.

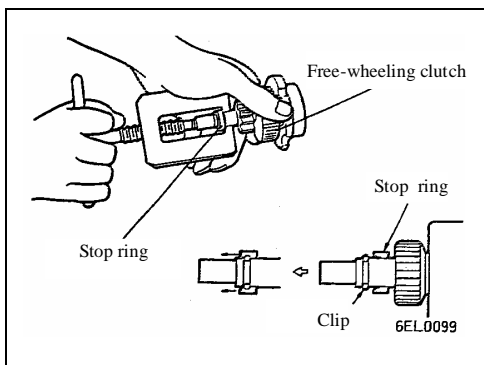


- (1) Check the insulation between the commutating piece of the commutator and the iron core of the rotator. No induction is normal.



#### Check of Rotator Coil Open-Circuit

- (1) Check the condition between the commutating pieces. Induction is normal.

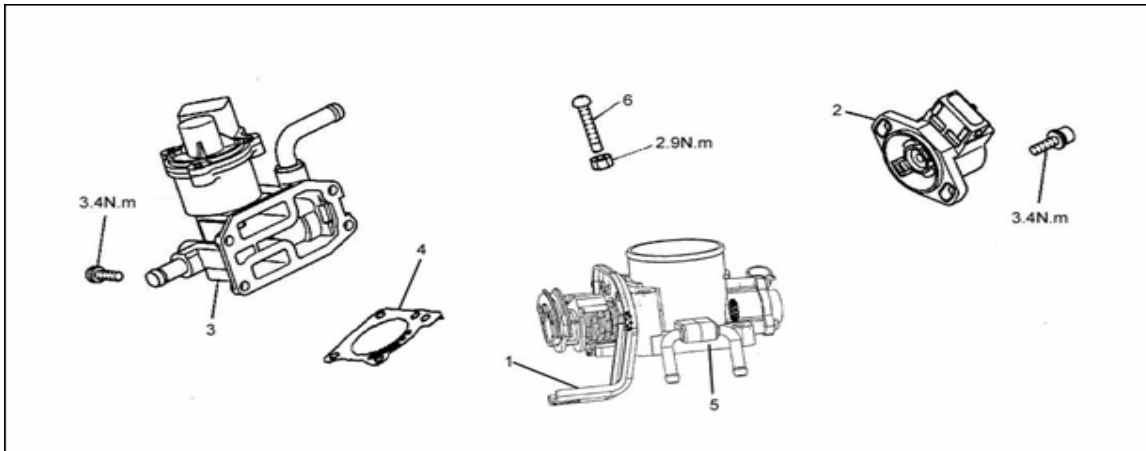


#### Notice for Assembly

##### Installation Retaining Ring and Clip

- (1) By using a suitable tool, pull the retaining ring in the direction of and beyond the clip.

## Throttle Body



### Removal Steps

1. Rack
2. Throttle position sensor
3. Idle air valve
4. O ring
5. Throttle body
6. Idle adjustment screw SAS

### Note:

1. No removal is required since SAS was well adjusted before ex-work.
2. If the fixed SAS is removed accidentally, it is necessary to refix the throttle speed adjustment screw.
3. If the throttle speed adjustment screw is removed accidentally, it is necessary to do readjustment.

### Cleaning of Throttle Body Parts

1. Clean all the throttle body parts. The following parts can not be cleaned with the cleaning agent:

- Throttle position sensor
- Idle control assembly

If these parts are immersed in the cleaning agent, their insulation is deteriorated. They can be cleaned only by wiping with cloth.

2. Check the vacuum port or passage for blockage. Clean the vacuum passage with compressed air.